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COLUMBIA RIVER BASIN FLOOD

MAY–JUNE 1948

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INTRODUCTION

The spring flood of 1948 in the Columbia River Basin caused the greatest destruction of record, with the loss of more than a score of lives and property damage estimated at more than 100 million dollars. It was second only to the flood of 1894 in volume of water.

The flood waters remained above critical flood stage for a long period, adding considerably to the damage. At Vancouver, Wash., the peak discharge was slightly over a million cubic feet per second and flow continued at nearly that rate for over two weeks. Because of the rapid initial rise and the long-continued pressure at near peak stages, there were many dike failures.

Some flooding occurs in the lowlands adjacent to the Columbia River and its important tributaries every year, but the frequency of extreme floods, such as the one of 1948, is quite low since a combination of several factors is necessary to produce a general flood of such extreme nature.

A heavy late-season accumulation of snow melted slowly in the early spring because of cold weather. Temperatures rose rapidly when warm weather finally arrived and, remaining high, resulted in very rapid late season melting. Unusually heavy rains swelled the rivers. In the upper Columbia Basin, the major tributaries reached crests within a period of 5 days. In the lower Snake River the crest was several weeks later than normal and therefore played a greater part than usual in raising the crest on the lower Columbia.

This paper presents a discussion of this destructive flood and the meteorological conditions over the Columbia Basin in the winter and spring of 1948 which, together with the general topography of the region, served to produce it.

DESCRIPTION OF BASIN

The Columbia River Basin, draining an area of 245,000 square miles, is the second largest in this country, being exceeded only by the Mississippi River System. In size it is slightly larger than the Colorado or the Ohio River Basin. Its average annual discharge is about 200,000 cubic feet per second (about 20 percent less than that of the Ohio) and its record peak flow (1894) is about 1,200,000 cubic feet per second, or about 40 percent less than that of the Ohio. In such a comparison, the Colorado River ranks very low, with average daily discharge of about 25,000 cubic feet per second (10 percent of the Columbia) and a record peak flow about 25 percent of that of the Columbia River.

A brief description of the topographical and climatological features of this large basin helps in the interpretation of the conditions which produced the flood.

TOPOGRAPHY

The Columbia River drains the area between the Cascade Mountains on the west and the Continental Divide on the east. Fig. 1 shows that the basin extends southward to the borders of California, Nevada, and Utah and northward into southeastern British Columbia, draining an area of nearly 40,000 square miles in Canada.

For purposes of this discussion the Columbia Basin is divided into three main subdivisions: The upper Columbia (above the Snake), the Snake River, and the lower Columbia (below the Snake).

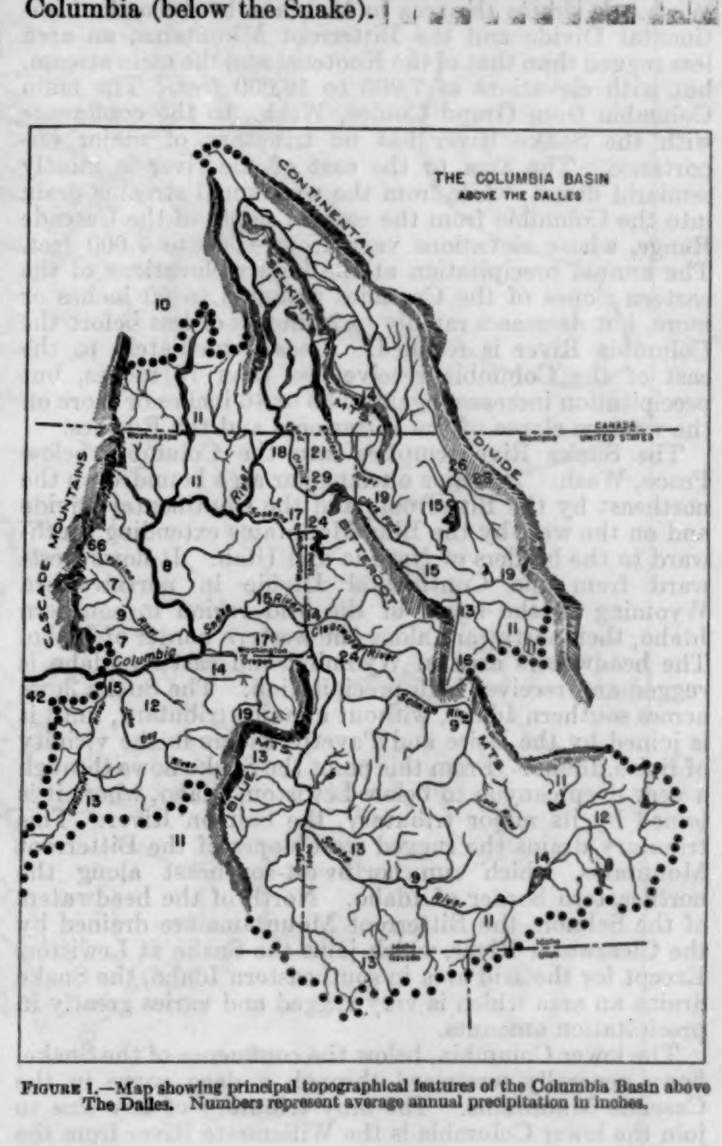


FIGURE 1.—Map showing principal topographical features of the Columbia Basin above The Dalles. Numbers represent average annual precipitation in inches.

The upper Columbia River Basin is composed of three main drainage basins: The main Columbia, the Kootenai, and the Clark Fork-Pend Oreille. The main stem of the upper Columbia runs northwestward in southeastern British Columbia between the Rocky Mountains (6,000 to 13,000 feet) and the Selkirk Mountains (4,000 to 12,000 feet) and then turns abruptly southward toward the United States border. In its southward journey the main stream drains the west slopes of the Selkirks and the east slopes of the Monashee Mountains. The topography along the Columbia in Canada is very rugged and this area has high winter precipitation. There are no important tributaries above the confluence with the Kootenai River. The Kootenai also has its headwaters between the Rockies and the Selkirks. It parallels the main stem but flows south-southeastward approximately 190 miles from its source to the United States border. After flowing through northwestern Montana and northern Idaho for about 120 miles, it reenters Canada to join the main course of the Columbia 30 miles north of the Washington border. The Kootenai runs through the same type of rugged narrow drainage area of high winter precipitation as the Columbia and also has no important tributaries. The Clark Fork-Pend Oreille River system flows into the Columbia in Canada just north of Boundary, Wash. It drains the area in Montana between the Continental Divide and the Bitterroot Mountains, an area less rugged than that of the Kootenai and the main stream, but with elevations of 7,000 to 10,000 feet. The main Columbia from Grand Coulee, Wash., to the confluence with the Snake River has no tributary of major importance. The area to the east of the river is mostly semiarid desert, while from the west small streams drain into the Columbia from the eastern slopes of the Cascade Range, whose elevations vary from 4,000 to 7,000 feet. The annual precipitation at the higher elevations of the eastern slopes of the Cascades amounts to 60 inches or more, but decreases rapidly to 20 inches or less before the Columbia River is reached. Areas immediately to the east of the Columbia receive less than 10 inches, but precipitation increases again to 30 or 40 inches or more on the western slopes of the Bitterroots and the Rockies.

The Snake River empties into the Columbia below Pasco, Wash. It drains a triangular area bounded on the northeast by the Bitterroots and the Continental Divide and on the west by the Blue Mountains extending southward to the borders of Nevada and Utah. It flows westward from the Continental Divide in northwestern Wyoming to the south of the arid region in southern Idaho, then northward along the western border of Idaho. The headwaters area in Wyoming and eastern Idaho is rugged and receives high precipitation. The Snake flows across southern Idaho, without a major tributary, until it is joined by the Boise and Payette Rivers in the vicinity of Boise, Idaho. From this point the Snake flows through a very deep canyon to below Lewiston, Idaho, where it is joined by its major tributary, the Salmon River. This tributary drains the rugged west slopes of the Bitterroot Mountains, which run northwest-southeast along the northeastern border of Idaho. North of the headwaters of the Salmon, the Bitterroot Mountains are drained by the Clearwater River, which joins the Snake at Lewiston. Except for the arid area in southeastern Idaho, the Snake drains an area which is very rugged and varies greatly in precipitation amounts.

The lower Columbia, below the confluence of the Snake, flows generally westward through a deep gorge in the Cascade Mountains. The only tributary of any size to join the lower Columbia is the Willamette River from the south at Portland, Oreg.

CLIMATOLOGY

The climate of the Columbia River Basin is determined primarily by its location within the zone of the prevailing westerlies and its proximity to an oceanic moisture source. There are striking climatic variations within the basin, however, which are explained by the topography of the region. The region is meteorologically dominated by the activities of the Aleutian Low and the Pacific High. These centers of action, with mean positions at about latitudes of 55° N. and 35° N., respectively, exhibit an annual migration associated with the march of solar altitude, centering farthest north in summer and farthest south in winter. Accompanying this migration, with the seasonal variation in contrast between land and sea temperatures providing a major cause, is the growth in intensity and extent of the Aleutian Low in winter and the simultaneous weakening of the Pacific High. Thus the basin comes within the influence of the Aleutian Low's circulation at the time of its greatest extent and intensity, with the result that the basin is then exposed to frequent cyclonic and frontal passages imbedded in the prevailing eastward or northeastward moving current of maritime air. Normally this moisture-laden air would deposit most of its moisture on the western slopes of the coastal mountains with less and less precipitation falling over the interior valleys as the air mass moves farther and farther from its source of moisture. However, in the winter season when the circulation of the Aleutian Low is most vigorous not only is the intensity of precipitation increased along the western slopes of the Coastal and Cascade Ranges, but also the normally lower intensities in the interior basins constituting the Columbia River system may be increased by temporary variations in such factors as carry-over, direction of flow, frontal passages, and instability. Thus the major portion of the annual precipitation over the basin is accumulated during the period from October to June, the maximum monthly average occurring in December. Figure 1 shows the average annual precipitation at selected stations in the Columbia Basin.

Because of the comparatively steep lapse rates in the cool maritime air, a high percentage of this precipitation falls as snow. This snow accumulates in packs of considerable depths at high elevations, with the water stored until the snow is melted during the spring thaws. As a result, a large portion of the Basin's annual precipitation is made available to the river in this spring period. If this accumulation is high, and it is melted rapidly by unusually high temperatures, high flows will result.

Normally, snow melt begins first in the southern portion of the Basin (Snake), progressing slowly northward with the runoff from southern tributaries passing out to sea before the arrival of the upper Columbia crest. If melting takes place simultaneously over the entire basin the total runoff will be increased enormously. If heavy rains occur at the same time, the possibilities of a major flood will be almost a certainty.

The conditions prerequisite to a major flood in the Columbia Basin are therefore:

1. Abnormally high accumulation of snow in the basin. This results from excessive precipitation plus abnormally low temperatures.
2. A period of excessively high spring temperatures over the entire basin.
3. Heavy rains coincident with the high temperatures.

This combination of events must develop in sequence over a period of about 6 months. Its probability is very small and consequently the frequency of extreme floods in the Columbia Basin is very low.

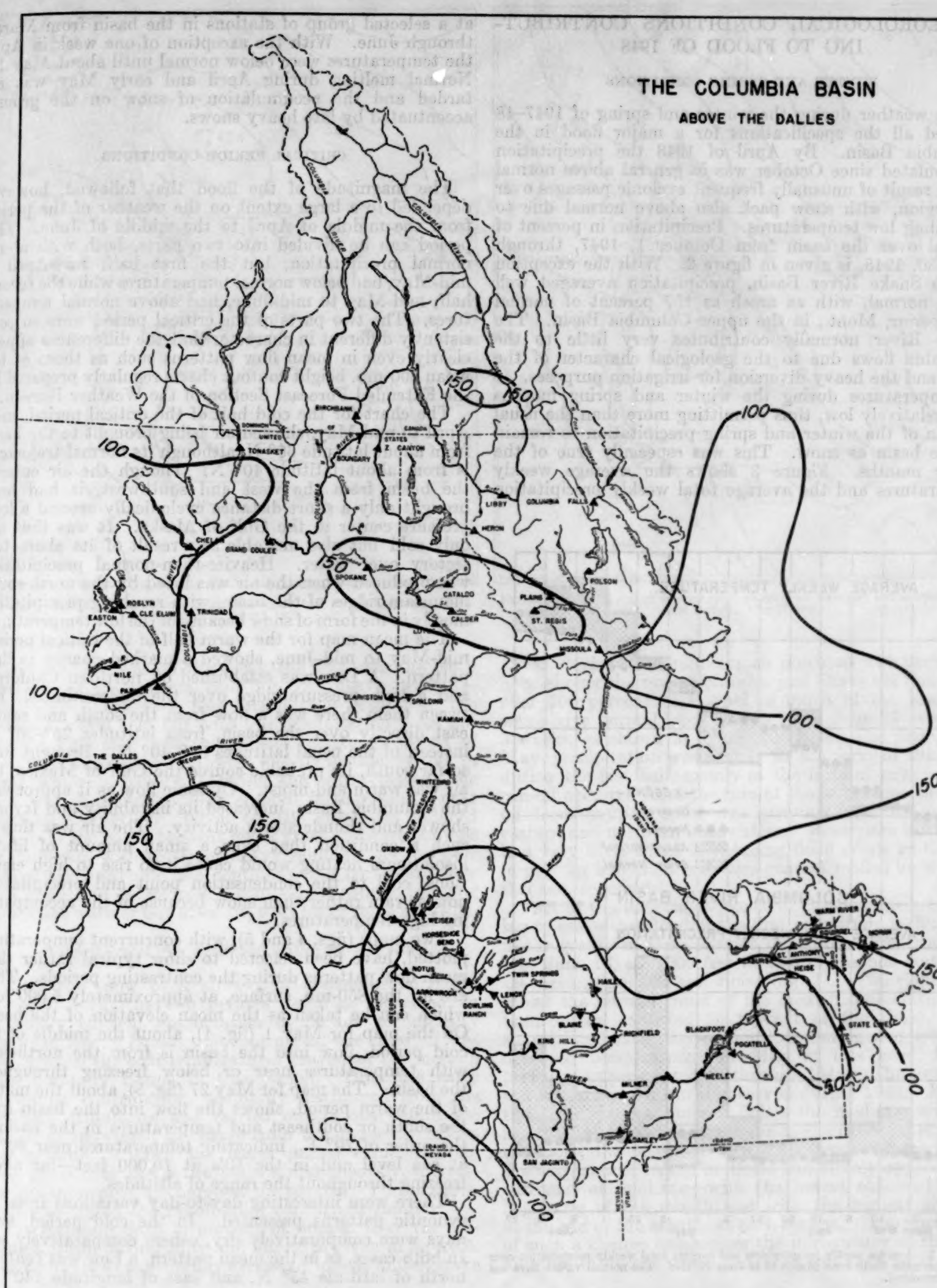


FIGURE 2.—Map showing isolines of precipitation in percent of normal over the Columbia Basin from October 1, 1947 to April 30, 1948.

METEOROLOGICAL CONDITIONS CONTRIBUTING TO FLOOD OF 1948

WINTER AND SPRING CONDITIONS

The weather during the winter and spring of 1947–48 fulfilled all the specifications for a major flood in the Columbia Basin. By April of 1948 the precipitation accumulated since October was in general above normal as the result of unusually frequent cyclonic passages over the region, with snow pack also above normal due to prevailing low temperatures. Precipitation in percent of normal over the basin from October 1, 1947, through April 30, 1948, is given in figure 2. With the exception of the Snake River Basin, precipitation averaged well above normal, with as much as 157 percent of normal at Superior, Mont., in the upper Columbia Basin. The Snake River normally contributes very little to the Columbia flows due to the geological character of the basin and the heavy diversion for irrigation purposes.

Temperatures during the winter and spring months were relatively low, thus permitting more than the usual portion of the winter and spring precipitation to remain on the basin as snow. This was especially true of the spring months. Figure 3 shows the average weekly temperatures and the average total weekly precipitation

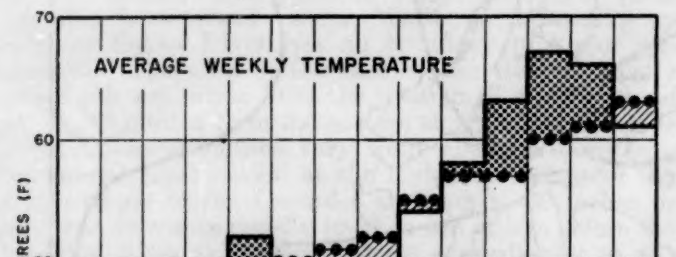


FIGURE 3.—Average weekly temperatures and average total weekly precipitation over the Columbia Basin from March 16 to June 22, 1948. The normal values have not been smoothed.

at a selected group of stations in the basin from March through June. With the exception of one week in April the temperatures were below normal until about May 15. Normal melting during April and early May was retarded and the accumulation of snow on the ground accentuated by late heavy snows.

CRITICAL PERIOD CONDITIONS

The magnitude of the flood that followed, however depended to a large extent on the weather of the period from the middle of April to the middle of June. This period can be divided into two parts, both with above normal precipitation, but the first half, mid-April to mid-May, had below normal temperatures while the second half, mid-May to mid-June, had above normal temperatures. The two parts of the critical period were so consistently different in character that the differences appear clearly even in mean flow patterns such as those of the mean 700-mb. height contour charts regularly prepared by the Extended Forecast Section of the Weather Bureau.

The chart for the cold half of the critical period, mid April to mid-May, showed air being brought to the basin from about latitude 60° N. although its normal trajectory is from about latitude 40° N. Though the air entered the basin from the west and southwest, it had been brought only a short distance cyclonically around a low-pressure center in the Gulf of Alaska. It was thus not only cold but also unstable as a result of its short trajectory over water. Heavier-than-normal precipitation was produced when the air was lifted by the north-south mountain ridges of the basin, with resulting precipitation mostly in the form of snow because of the low temperatures.

The mean map for the warm half of the critical period, mid-May to mid-June, showed a marked change in flow pattern. A Low was established off northern California and a high pressure ridge over the midcontinent. Between them there was a flow from the south and southeast directly over the basin, from latitudes 25°–30° N. instead of the usual latitudes 35°–40° N. Brought from so far south, its probable source the Gulf of Mexico, the air was warm and moist. Cyclonic flow as it approached the Columbia Basin, increased its instability and favored shower and thunderstorm activity. The air was thus in such a condition that even a small amount of lift or insolational heating would cause it to rise to high elevations, cool to the condensation point and precipitate—now as rain rather than snow because of the accompanying high temperatures.

Two maps (figs. 4 and 5), with concurrent temperatures plotted, have been selected to show typical rather than mean flow patterns during the contrasting periods. They are for the 850-mb. surface, at approximately 5,000 feet, which can be taken as the mean elevation of the basin. On the map for May 1 (fig. 4), about the middle of the cold period, flow into the basin is from the northwest, with temperatures near or below freezing throughout the basin. The map for May 27 (fig. 5), about the middle of the warm period, shows the flow into the basin from the south or southeast and temperatures in the basin of the order of 70° F., indicating temperatures near 90° F. at sea level and in the 50's at 10,000 feet—far above freezing throughout the range of altitudes.

There were interesting day-to-day variations from the synoptic patterns presented. In the cold period, some days were comparatively dry, others comparatively wet. In both cases, as in the mean pattern, a Low was centered north of latitude 45° N. and east of longitude 140° W.

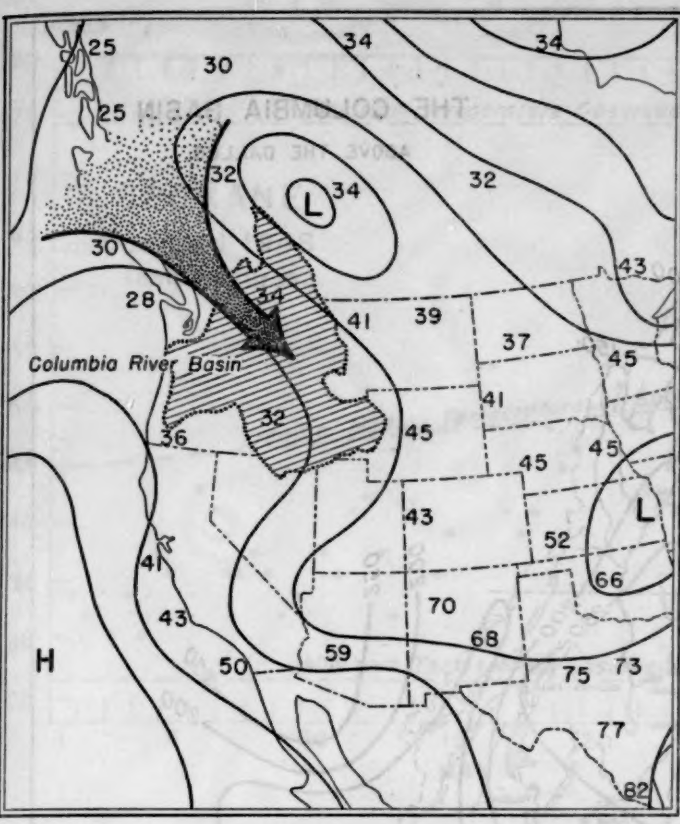


FIGURE 4.—850-mb. height contour chart showing air flow and temperatures (° F.) 1900 P. S. T., May 1, 1948.

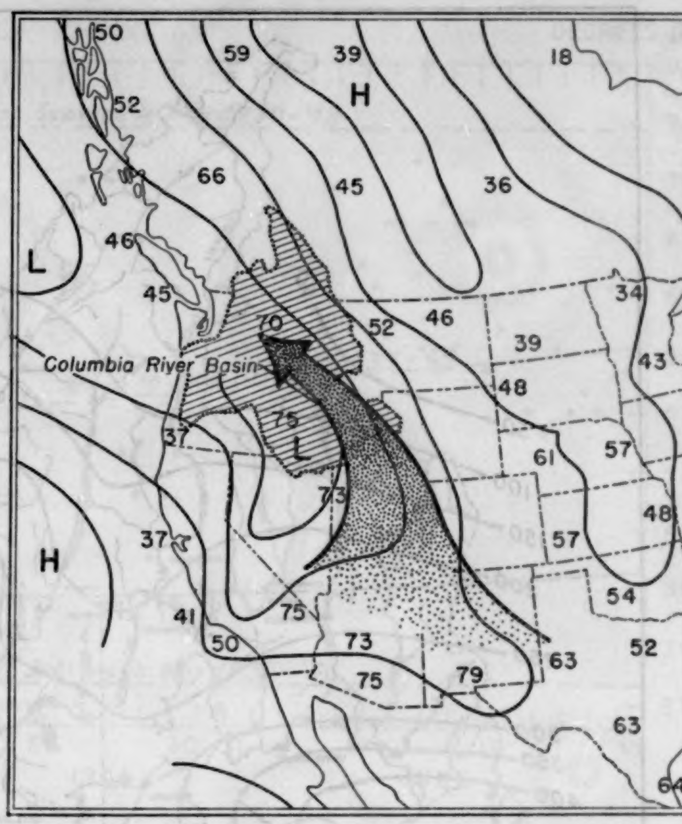


FIGURE 5.—850-mb. height contour chart showing air flow and temperatures (° F.), 1900 P. S. T., May 27, 1948.

When the Low was off the coast, the flow over the basin was from the southwest, cold but with heavy precipitation. When the Low was inland, flow was from the northwest, still cold but with less precipitation. An important difference was the greater moisture content of the current from the southwest and its instability due to short water trajectory. During the warm period, the Low was characteristically centered farther south, near northern California. When off the coast, its induced flow from the south brought air of great moisture content to the basin, with resultant heavy rainfall. As the Low moved eastward into the continent, the northward flow was more and more from a continental source, bringing somewhat warmer but drier air, with lesser rains resulting.

COMBINATION OF FLOOD-PRODUCING FACTORS

With the snow pack already of above-normal depth in early April, the two periods described provided an unusually efficient combination of factors to intensify the flood flow. During the cold period the snowfall was heavy while the cold temperatures prevented the melting that normally begins in this period. Thus the early snow-melt contribution, ordinarily discharged from the southern tributaries and carried out to sea before the arrival of snow-melt discharge from the upper Columbia, was retarded. When the warm period came, melting took place over the entire basin simultaneously, increasing the snow-melt discharge at the mouth. To the snow-melt was added the runoff from concurrent rainfall.

Precipitation data in percent of normal over the Columbia Basin during May and June are given in figure 6. The amounts were generally excessive, except in the Snake River Basin, with amounts as much as 440 percent of normal over the main Columbia just above the Snake and over 200 percent of normal in much of the basin. It was above normal from March 16 to June 22 except for 3 weeks, as shown in figure 3. During the first half of May, precipitation was largely in the form of snow, and during the last half, mainly in the form of rain. Heavy run-off occurred from the rain at the same time that run-off from melting snow was arriving from the extreme eastern and northern headwaters. Reservoirs in the area had very little effect in reducing flood crests as they are largely for irrigation and were generally filled by the time this rain occurred.

Part of the unusual sequence of circumstances combining to make this flood of the first magnitude is illustrated in the graphs of the variation of temperature, from May 1 to June 15, at 5,000 feet at two radiosonde stations in the basin, Spokane and Boise (fig. 7). The sloping line shows the normal trend of the median temperature (the temperature exceeded 50 percent of the time). Horizontal lines show the extreme maximum and minimum observed temperatures for May at this level, for the period of upper-air record through 1948. The dots show the actual temperatures observed during 1948. Most of the 1948 observations fall below the median during the first half of May and above the median thereafter. Furthermore, the observed May 1948 temperatures include the extremes of record at Boise and closely approach the extremes at Spokane—with the lowest observed at the beginning of the month and with the highest observed at the end of the month, at each station. The abruptness of such a change emphasizes the infrequency of the combination of events which produced the 1948 flood.

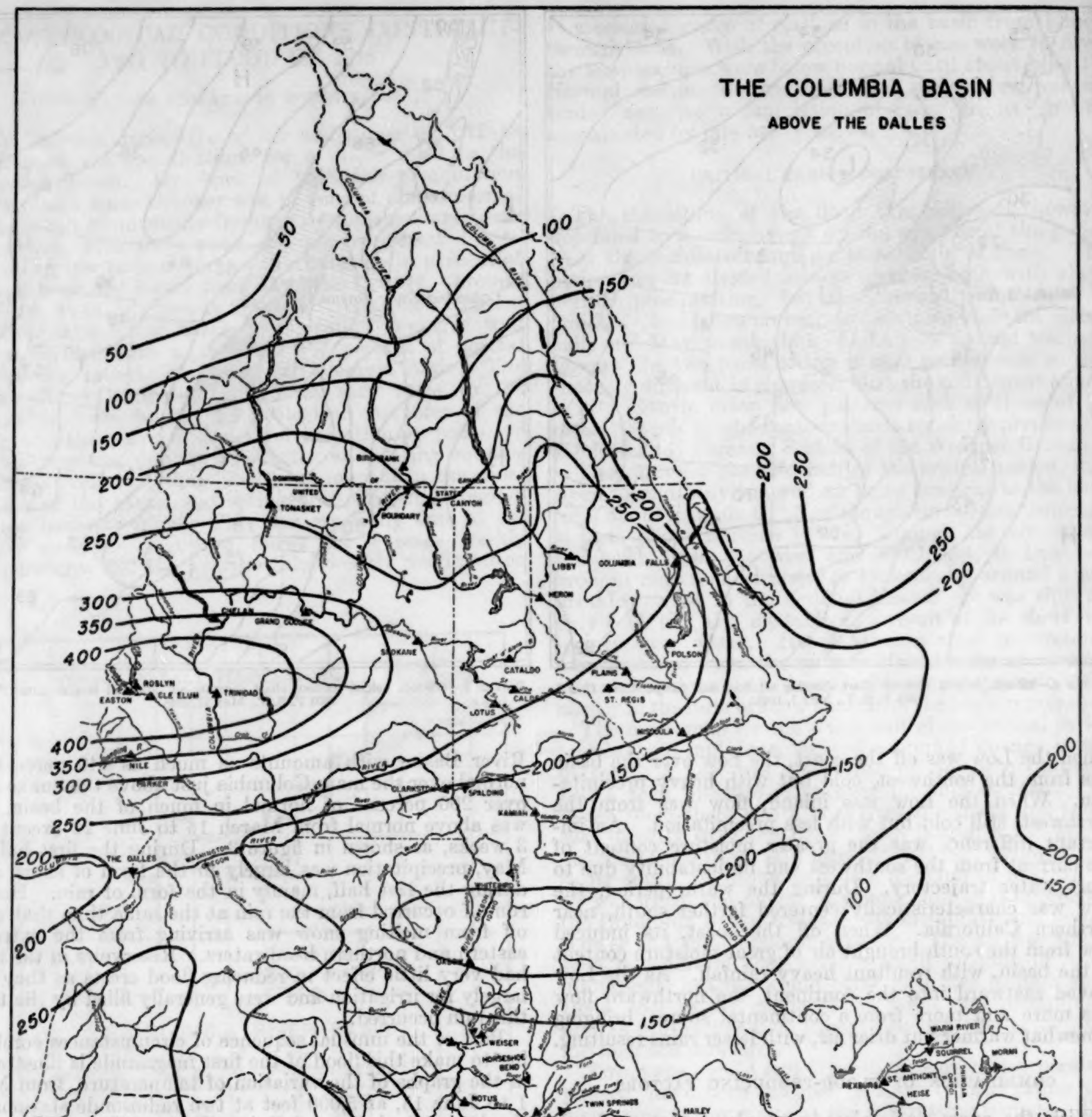


FIGURE 6.—Map showing isolines of precipitation in percent of normal over the Columbia Basin from May 1 to June 30, 1948.

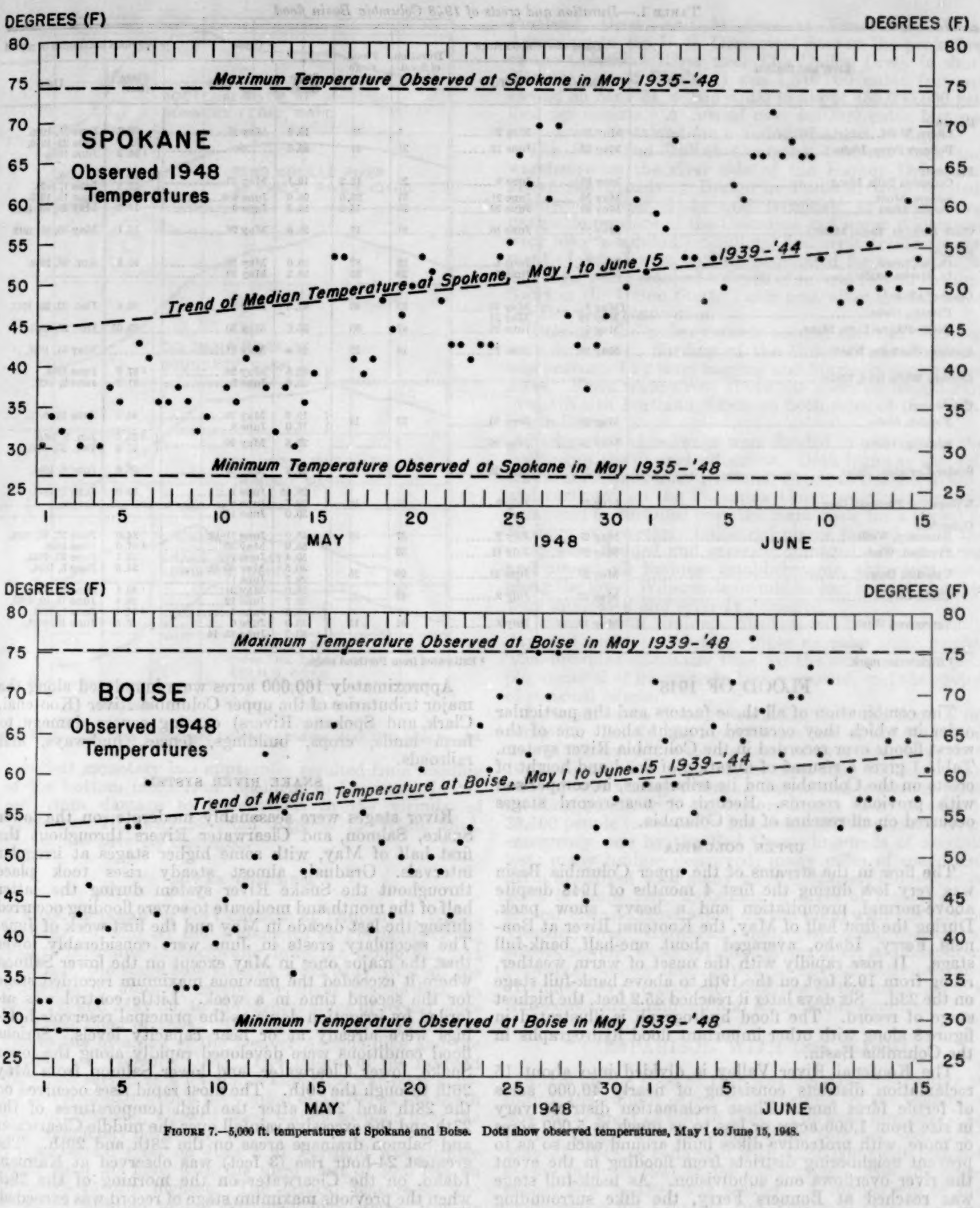


FIGURE 7.—5,000 ft. temperatures at Spokane and Boise. Dots show observed temperatures, May 1 to June 15, 1948.

TABLE 1.—*Duration and crests of 1948 Columbia Basin flood*

River and Station	Dates above flood stage: From—	Dates above flood stage: To—	Duration of flood (days)	Flood stage (feet)	Crest: Stage (feet)	Crest: Date	Previous maximum of record: Stage (feet)	Previous maximum of record: Date
Kootenai:								
Libby, Mont.	May 25	May 29	5	18	19.9	May 28	20.7	June 21, 1916.
Bonners Ferry, Idaho	May 23	June 12	21	31	35.3	do	32.7 [1] 34.2	June 22, 1916. June 1894.
Flathead:								
Columbia Falls, Mont.	May 19	June 9	22	13.2	19.1	May 23	[1] 22.7 17.3	Do. June 1, 1923.
Somers, Mont.	May 26	June 21	27	93.0	96.0	June 6–8	96.3	June 19, 1933.
Polson, Mont.	May 25	June 22	29	15.6	19.2	June 6	17.1	May 29, 30, 1928.
Clark Fork: St. Regis, Mont.	May 21	June 10	21	17	20.0	May 24	19.1	May 30, 31, 1913.
St. Joe:								
Calder, Idaho	May 18	June 4	18	87	89.0	May 28	93.1	Apr. 18, 1938.
St. Maries, Idaho	May 19	June 7	20	35	39.2	May 30		
Coeur d'Alene:								
Cataldo, Idaho	May 8 May 13	May 10 May 31	22	40	47.5	May 21	56.9	Dec. 22, 23, 1933.
Coeur d'Alene Lake, Idaho	May 1	June 16	47	30	36.0	May 30	39.05	Dec. 25, 1933.
Spokane: Spokane, Wash.	May 23	June 7	16	27	28.4	May 31		May 31, 1894.
Salmon: White Bird, Idaho					32.5 33.0	May 29 June 3	[1] 37.5 31.2	June 1894. June 9, 1921.
Clearwater:								
Kamiah, Idaho	May 20	June 10	22	14	19.2 15.0	May 29 June 8	16.5	June 10, 1933.
Spalding, Idaho	May 28	May 29	2		23.8	May 29	[1] 25.6 23.2	Jan. 5, 1928. Dec. 23, 1933.
Snake: Lewiston, Idaho	May 29	May 29	1	22	22.8	May 29	26.0	June 6, 1894.
Willamette: Portland, Oreg.	May 22	July 3	43	18	29.95 29.7 30.0	June 1 June 6 June 14	33.0	June 7, 1894.
Columbia:								
Boundary, Wash.	May 27	July 2	37	32	45.0	June 11–12	34.0	June 27, 28, 1938.
Trinidad, Wash.	May 21	July 11	52		56.9 59.4	May 30 June 12	[1] 61.0 52.5	June 1894. June 23, 1933.
Umatilla, Oreg.	May 27	June 21	26	25	30.5 29.7	May 30–31 June 11	34.5	June 5, 1894.
Celilo, Oreg.	May 22	July 2	42		34.6 33.7	May 31 June 12	[1] 40.1 23.4	June 6, 1894. June 18, 19, 1903.
Vancouver, Wash.	May 19	July 8	51	15	30.2 30.0 30.2	June 1 June 6 June 13, 14	[2] 34.4 25.5	June 7, 1894. June 19, 1933.

[1] High water mark.
[2] Estimated from Portland stage.

FLOOD OF 1948

The combination of all these factors and the particular order in which they occurred brought about one of the worst floods ever recorded in the Columbia River system. Table 1 gives a résumé of duration of flood and height of crests on the Columbia and its tributaries, in comparison with previous records. Record or near-record stages occurred on all reaches of the Columbia.

UPPER COLUMBIA

The flow in the streams of the upper Columbia Basin was very low during the first 4 months of 1948 despite above-normal precipitation and a heavy snow pack. During the first half of May, the Kootenai River at Bonners Ferry, Idaho, averaged about one-half bank-full stage. It rose rapidly with the onset of warm weather, rising from 19.3 feet on the 19th to above bank-full stage on the 23d. Six days later it reached 35.2 feet, the highest stage of record. The flood hydrograph is illustrated in figure 8 along with other important flood hydrographs in the Columbia Basin.

The Kootenai River Valley is divided into about 15 reclamation districts consisting of nearly 40,000 acres of fertile farm land. These reclamation districts vary in size from 1,000 acres or less to as much as 5,000 acres or more, with protective dikes built around each so as to prevent neighboring districts from flooding in the event the river overflows one subdivision. As bank-full stage was reached at Bonners Ferry, the dike surrounding Reclamation District No. 7 crumbled, flooding 2,300 acres of wheat land. As the dikes failed every Reclamation District in the valley was flooded to depths of 10 to 15 feet.

Approximately 160,000 acres were inundated along the major tributaries of the upper Columbia River (Kootenai, Clark, and Spokane Rivers) causing severe damage to farm lands, crops, buildings, fences, highways, and railroads.

SNAKE RIVER SYSTEM

River stages were seasonably moderate, on the lower Snake, Salmon, and Clearwater Rivers throughout the first half of May, with some higher stages at irregular intervals. Gradual, almost steady rises took place throughout the Snake River system during the latter half of the month and moderate to severe flooding occurred during the last decade in May and the first week of June. The secondary crests in June were considerably lower than the major ones in May except on the lower Salmon where it exceeded the previous maximum recorded stage for the second time in a week. Little control was afforded by irrigation dams as the principal reservoir holdings were already at or near capacity levels. Serious flood conditions were developed rapidly along the lower Snake, lower Clearwater, and lower Salmon from May 26th through the 30th. The most rapid rises occurred on the 28th and 29th after the high temperatures of the 27th and the excessive rainfall over the middle Clearwater and Salmon drainage areas on the 28th and 29th. The greatest 24-hour rise (3 feet) was observed at Kamiah, Idaho, on the Clearwater on the morning of the 29th when the previous maximum stage of record was exceeded. The Snake River exceeded bank-full stage near Menan, Idaho, about June 1, inundating farm lands in the area until about the 20th. The greatest flooding occurred on June 10, when 3,000 to 5,000 acres were under water.

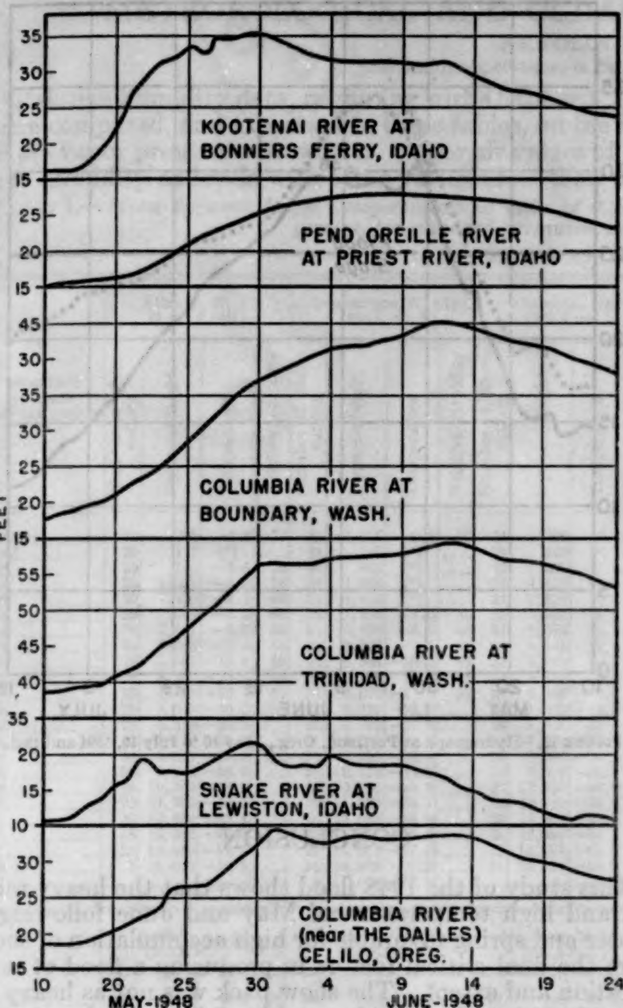


FIGURE 8.—Flood stage hydrographs for selected stations, May 10 to June 24, 1948.

Heaviest monetary loss apparently resulted from flooding of the bottom lands from Spalding to Lewiston, Idaho, and from damage to installations in the vicinity of Lewiston. Highway 95 from Riggins to White Bird, Idaho, was severely damaged.

LOWER COLUMBIA

Flooding began on the Columbia at Vancouver, Wash., on May 19, and on the Willamette at Portland, Oreg., 3 days later due to backwater from the Columbia. At Portland, the stage rose steadily from May 16 until the afternoon of June 1, except for slight fluctuations on May 18, and May 30, to the highest stage of record since the great flood of 1894. The slight fall on May 30 was due to the breaking of the Denver Avenue dike and the flooding of Vanport, Oreg. The failure of the railroad fill which served as a levee at Vanport, a war-born housing development with a population of 18,700 at the north edge of Portland, allowed flood waters to pour over the city completely destroying it.

The second crest on June 6 at Portland was slightly lower than the first, with the third crest of 30.0 feet on June 13–14 the highest. The critical feature of the flood, in addition to the extremely high stages, was its long duration, above-flood stage continuing 43 days at Portland, Oreg., and 51 days at Vancouver, Wash. According to the U. S. Geological Survey the peak flow of the Columbia River near The Dalles, Oreg. (a short distance east of Portland), was 1,010,000 cubic feet per second on May 31, a rate equal to about 450,000,000 gallons per minute. A flow of over 900,000 cubic feet per second was sustained for a period of about 17 days.

The Pope and Talbot Company terminal dock and warehouse on the river side of the Harbor Drive just above the Broadway Bridge in Portland were flooded. Numerous other docks and terminals at cities along navigable portions of the Columbia and lower Willamette were also inundated. Shipping and river traffic (movement of ships) were entirely prohibited for several days. The high water reached a depth of several feet on the first floors in the Union Stock Yards area after the failure of the Denver Avenue dike.

Although the railway yards around the Union Depot were inundated, flooding of the Union Station building was prevented by sand bagging and hurriedly constructed dikes. Flood waters rose above the doors on freight cars in the North Portland Yards on both sides of the Willamette River.

Highways and railways were flooded in addition to the flooding of the drainage districts. Both highway and rail traffic northward from Portland, Oreg., to Seattle, Wash., and eastward up the Columbia Gorge were considerably hampered or curtailed over the main route for a period of 10 days to 2 weeks. Industrial plants located along the river were flooded and severely damaged. Truck farms and almost all business establishments, shipyards, etc., along the lower Willamette or middle and lower Columbia were inundated and severely damaged.

Crews in most drainage districts worked continuously day and night to reinforce dikes or raise their height. This provided additional time for the evacuation of people, removal of livestock to higher ground, and the saving of personal effects.

Information on damages resulting from the flood is incomplete. Briefly, the approximate cost of the 1948 flood was as follows: More than a score of lives lost; more than 100 million dollars in damages; more than 700 homes destroyed (490 were government-owned and contained 6,809 dwelling units), with 4,480 more homes badly damaged; 38,500 people temporarily homeless; 53,500 persons given emergency care by the Red Cross; hundreds of animals lost; many bridges destroyed; many miles of roads and dikes destroyed with many more damaged; thousands of acres of crops lost; thousands of acres of topsoil gone; several towns almost wiped off the map, with the city of Vanport, Oreg., completely destroyed; much damage to streets, sewers, water systems, power lines, and telephone networks; serious interruption to normal activities and extended loss of use of such facilities as the main line of a transcontinental railroad and some major airports.

COMPARISON WITH 1894 FLOOD

Although the flood of 1948 was the most destructive of record, the volume of water discharged by the Columbia was not as great as that of 1894. The peak flow near The Dalles, Oreg., was 1,010,000 cubic feet per second on May 31, 1948 as compared with 1,240,000 cubic feet per second in June 1894 at the same place. Also the antecedent flow in 1894 was greater. A comparison of the hydrographs for Umatilla and Portland, Oreg., for the 2 floods is given in figures 9 and 10, respectively.

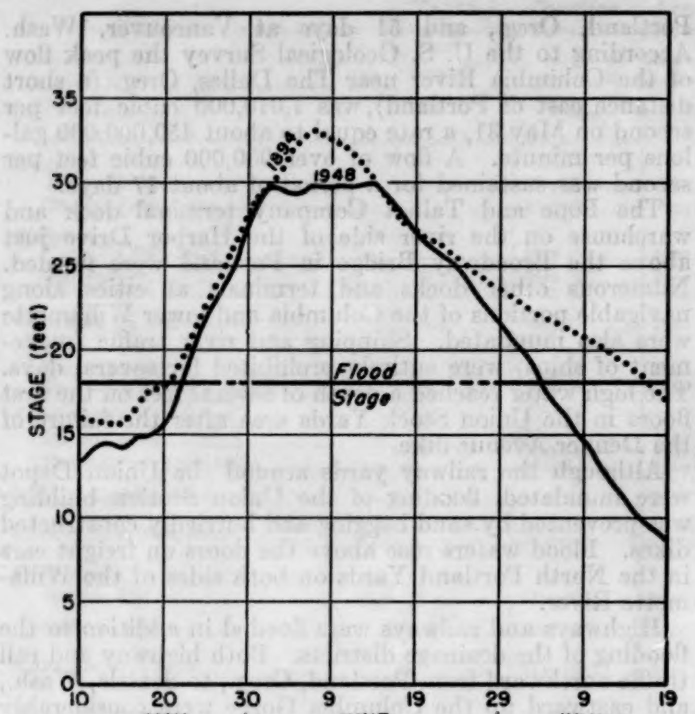


FIGURE 9.—Hydrograph at Umatilla, Oreg., May 10 to July 19, 1894 and 1948.

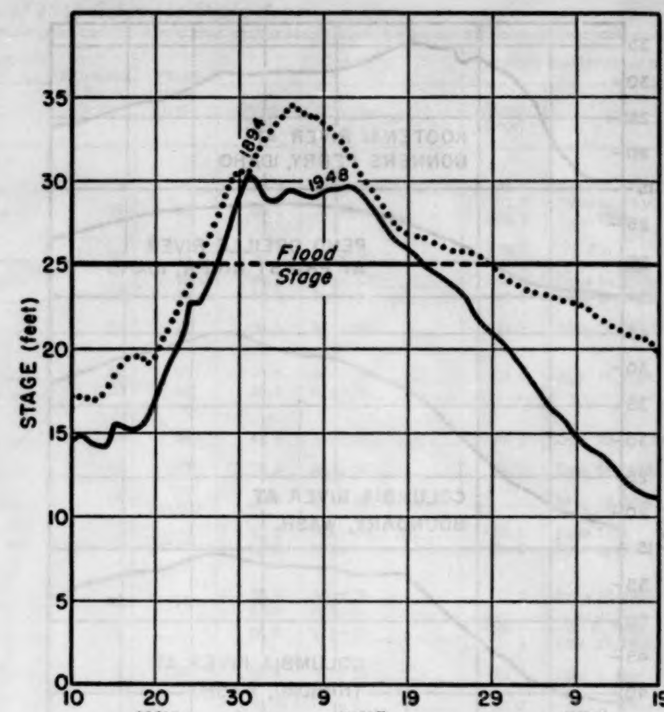


FIGURE 10.—Hydrograph at Portland, Oreg., May 10 to July 19, 1894 and 1948.

Weather conditions were somewhat different in the 2 seasons. Precipitation was much heavier during the winter of 1893–94 than in the winter of 1947–48. Therefore a heavier snow pack was available for runoff in 1894. Also, the spring season of 1894 was warmer and drier than the early months of 1948, resulting in an earlier runoff than in 1948. Table 2 shows the precipitation amounts for May 1894 and May 1948 over the Columbia Basin.

TABLE 2.—*Comparative precipitation, Columbia River Basin, May 1894 and May 1948*

Basin and station	Precipitation (inches)	
	May 1894	May 1948
Snake:		
Baker, Oreg	2.43	1.80
Boise, Idaho	2.08	1.09
Walla Walla, Wash	1.01	3.13
Upper Columbia:		
Missoula, Mont	1.43	3.96
Spokane, Wash	1.01	5.74
Lower Columbia:		
Portland, Oreg	1.09	3.88
Roseburg, Oreg	1.73	2.93
Seattle, Wash	1.99	4.59

CONCLUSION

This study of the 1948 flood shows that the heavy rainfall and high temperature of May and June following a winter and spring favorable for high accumulation of snow were the final critical factors in producing a flood of such duration and extent. The snow pack was not as heavy as that of 1894, and probably would not have produced such a disastrous flood of itself. The addition of heavy runoff from excessive rainfall to the late season snow melt was enough to tip the scales in the direction of high river stages and serious loss of life and property.

ACKNOWLEDGMENTS

Special acknowledgment is due Mr. Bennett Swenson, Chief of the River Services Section, for valuable suggestions and assistance in the preparation of this report, A. L. Shands of the Hydrometeorological Section for preparation of material on meteorology, and others of the Division of Climatological and Hydrologic Services for their valuable contributions. Acknowledgment is also due the Regional Office Seattle, Wash., and other field offices (Portland, Oreg., Spokane, Wash., Boise, Idaho, and Wenatchee, Wash.) for their excellent reports on the flood.

METEOROLOGICAL AND CLIMATOLOGICAL DATA FOR JANUARY 1949

AEROLOGICAL OBSERVATIONS

[For description of change in Table 1 and charts, see REVIEW, January 1946, p. 6]

Relative humidity data, beginning with October 1, 1948, were computed, and expressed in these tables, on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. Therefore, relative humidity data for the period after October 1, 1948, should not be combined with earlier data without necessary conversion.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during January 1949*

STATIONS AND MEAN SURFACE PRESSURES

Standard pressure surface (mb.)	Albany, N. Y. (1,011.8 mb.)				Albuquerque, N. Mex. (835.6 mb.)				Atlanta, Ga. (987.9 mb.)				Big Spring, Tex. (930.2 mb.)				Bismarck, N. Dak. (960.2 mb.)				Boise, Idaho (922.1 mb.)				Brownsville, Tex. (1,018.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	29	86	−2.1	77	31	1,620	−0.1	60	31	300	10.4	76	31	774	1.3	70	31	505	−16.2	76	31	868	−11.8	75	31	6	14.0	83
1,000	29	177	(*)	----	31	156	(*)	----	31	197	(*)	----	31	182	(*)	----	31	194	(*)	----	31	239	(*)	----	31	158	13.9	82
950	29	588	−3.5	70	31	583	(*)	----	31	630	11.4	71	31	608	(*)	----	31	587	−17.3	71	31	640	(*)	----	31	596	14.0	76
900	29	1,011	−4.6	74	31	1,024	(*)	----	31	1,078	10.6	67	31	1,039	2.2	65	31	991	−13.3	67	31	1,054	−10.3	65	31	1,048	13.6	70
850	29	1,460	−4.7	69	31	1,483	(*)	----	31	1,554	9.7	65	31	1,501	3.6	62	31	1,429	−10.9	63	31	1,493	−10.6	61	31	1,529	12.4	67
800	29	1,938	−4.8	60	31	1,968	−1.0	58	31	2,057	8.2	57	31	1,994	3.5	56	31	1,896	−10.2	60	31	1,961	−9.7	56	31	2,037	11.5	58
750	29	2,451	−5.9	56	31	2,485	−3.9	60	31	2,589	5.5	48	31	2,525	1.6	54	31	2,390	−11.2	57	31	2,460	−11.3	53	31	2,585	10.0	48
700	29	2,983	−7.9	54	31	3,022	−7.1	61	31	3,148	2.6	48	31	3,070	−.8	54	31	2,920	−13.1	54	31	2,984	−13.8	52	31	3,147	7.4	41
650	29	3,561	−10.6	52	31	3,604	−10.2	60	31	3,749	.3	40	30	3,665	−4.0	52	31	3,490	−15.8	53	31	3,549	−16.9	49	31	3,757	3.8	32
600	29	4,169	−13.2	48	31	4,209	−13.3	53	31	4,383	−3.3	42	30	4,287	−7.4	51	31	4,082	−18.9	53	31	4,140	−20.3	45	31	4,398	.0	----
550	29	4,831	−16.4	49	31	4,872	−17.3	45	31	5,066	−7.2	40	29	4,961	−11.4	50	31	4,724	−23.0	----	31	4,780	−24.4	----	31	5,091	−4.5	----
500	29	5,540	−20.6	----	31	5,574	−22.1	----	31	5,803	−12.2	39	29	5,684	−15.9	47	31	5,416	−27.6	----	30	5,461	−29.0	----	31	5,832	−9.6	----
450	29	6,318	−25.2	----	31	6,347	−27.1	----	29	6,605	−17.3	42	29	6,478	−20.8	----	30	6,167	−32.6	----	30	6,210	−33.4	----	31	6,649	−15.1	----
400	29	7.158	−31.1	----	31	7,180	−32.6	----	29	7,471	−23.3	----	29	7,333	−26.9	----	30	6,984	−38.6	----	30	7,026	−38.6	----	31	7,517	−21.7	----
350	29	8,091	−37.8	----	31	8,109	−38.3	----	29	8,434	−30.7	----	29	8,283	−33.4	----	29	7,897	−44.6	----	30	7,932	−43.8	----	31	8,487	−28.9	----
300	28	9,148	−45.5	----	31	9,155	−44.2	----	28	9,503	−39.4	----	29	9,347	−41.4	----	29	8,916	−49.8	----	29	8,962	−48.8	----	31	9,570	−37.4	----
250	28	10,342	−53.3	----	30	10,366	−49.8	----	27	10,720	−49.9	----	29	10,560	−49.9	----	27	10,103	−53.7	----	27	10,156	−53.0	----	31	10,803	−46.8	----
200	22	11,762	−59.7	----	29	11,820	−54.1	----	25	12,143	−59.9	----	26	12,010	−56.2	----	20	11,532	−53.6	----	26	11,596	−53.7	----	27	12,240	−57.2	----
175	20	12,584	−60.4	----	26	12,682	−54.6	----	23	12,964	−63.6	----	23	12,839	−57.9	----	17	12,374	−53.8	----	24	12,448	−52.8	----	25	13,076	−61.7	----
150	18	13,532	−59.6	----	25	13,661	−55.2	----	21	13,899	−64.7	----	19	13,818	−59.3	----	13	13,375	−53.0	----	22	13,437	−53.4	----	19	14,035	−63.0	----
125	13	14,649	−59.4	----	21	14,803	−57.4	----	15	15,004	−65.8	----	13	14,951	−62.1	----	5	14,598	−52.7	----	18	14,605	−53.8	----	16	15,155	−66.2	----
100	8	16,008	−59.5	----	16	16,203	−60.3	----	11	16,334	−68.3	----	6	16,291	−64.1	----	----	----	----	----	15	16,054	−55.2	----	7	16,487	−71.6	----
80	----	----	----	----	8	17,588	−59.2	----	----	----	----	----	----	----	----	----	----	----	----	----	10	17,458	−56.0	----	----	----	----	----

Standard pressure surface (mb.)	Buffalo, N. Y. (992.6 mb.)				Camaguey, Cuba (1,006.0 mb.)				Caribou, Maine (996.4 mb.)				Charleston, S. C. (1,021.6 mb.)				Ciudad Victoria, Mex. (977.6 mb.)				Columbia, Mo. (992.2 mb.)				Dodge City, Kans. (926.8 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	221	−0.6	78	30	122	18.8	92	31	191	−10.7	79	31	13	12.2	83	30	335	17.3	61	31	239	−1.8	80	31	792	−6.2	73
1,000	31	161	(*)	----	30	174	19.8	88	31	160	(*)	----	31	193	15.1	72	30	140	(*)	----	31	175	(*)	----	31	189	(*)	----
950	31	575	−1.8	75	30	620	18.4	81	31	557	−10.4	72	31	632	14.2	64	30	581	15.8	63	31	586	−2.3	76	31	598	(*)	----
900	31	999	−2.8	71	30	1,080	16.0	72	31	972	−10.8	67	31	1,084	12.7	61	30	1,036	14.2	66	31	1,013	−.2	67	31	1,020	−5.3	66
850	31	1,452	−3.9	68	30	1,564	13.5	60	31	1,411	−11.1	63	31	1,562	10.5	59	30	1,518	12.6	68	31	1,472	1.0	57	31	1,472	−2.5	60
800	31	1,930	−4.6	67	30	2,073	12.0	44	31	1,876	−11.3	56	31	2,066	8.3	52	30	2,026	11.7	70	31	1,959	−.2	53	31	1,954	−1.3	55
750	31	2,444	−5.3	57	30	2,619	11.1	----	31	2,374	−12.0	48	31	2,601	6.5	43	30	2,571	10.0	60	31	2,479	−1.5	51	31	2,470	−3.0	56
700	31	2,976	−7.2	58	30	3,185	8.4	----	31	2,897	−13.4	45	31	3,161	3.8	39	30	3,137	7.1	53	31	3,022	−3.3	48	31	3,011	−5.5	48
650	31	3,557	−9.3	52	30	3,800	5.5	----	31	3,466	−15.5	43	31	3,761	.5	39	30	3,748	4.0	37	31	3,610	−6.1	48	31	3,504	−8.2	41
600	31	4,167	−12.4	48	29	4,445	2.0	----	31	4,059	−18.6	44	31	4,397	−3.2	37	30	4,391	.6	----	31	4,227	−9.7	46	31	4,207	−11.9	41
550	30	4,832	−15.5	44	29	5,145	−2.6	----	31	4,705	−22.2	----	31	5,081	−7.1	35	30	5,086	−3.7	----	31	4,896	−13.6	42	31	4,871	−15.6	38
500	28	5,545	−19.4	43	29	5,890	−8.0	----	31	5,398	−26.3	----	31	5,819	−11.4	32	30	5,831	−8.9	----	31	5,613	−17.9	39	31	5,581	−20.1	37
450	28	6,322	−24.4	----	28	6,706	−14.2	----	30	6,170	−30.9	----	31	6,626	−16.9	35	30	6,649	−14.4	----	31	6,400	−23.4	----	30	6,370	−25.5	----
400	27	7,170	−30.3	----	28	7,582	−21.1	----	30	6,990	−36.1	----	30	7,490	−23.2	----	30	7,525	−20.5	----	30	7,253	−29.1	----	30	7,208	−31.6	----
350	27	8,107	−36.9	----	28	8,551	−29.1	----	30	7,905	−41.9	----	30	8,453	−30.5	----	29	8,498	−27.9	----	30	8,194	−35.8	----	30	8,139	−38.0	----
300	25	9,152	−43.9	----	28	9,633	−37.9	----	30	8,935	−47.6	----	29	9,531	−39.1	----	29	9,587	−36.3	----	29	9,258	−43.0	----	30	9,185	−44.4	----
250	20	10,366	−51.4	----	26	10,864	−47.9	----	29	10,122	−52.3	----	26	10,754	−49.3	----	29	10,826	−46.5	----	26	10,479	−50.8	----	28	10,406	−50.4	----
200	12	11,799	−56.5	----	26	12,302	−57.7	----	25	11,546	−54.0	----	21	12,191	−59.4	----	28	12,274	−57.8	----	14	11,888	−57.9	----	24	11,840	−55.5	----
175	9	12,676	−57.9	----	26	13,136	−62.3	----	22	12,404	−53.3	----	17	13,025	−62.7	----	28	13,105	−63.2	----	10	12,725	−60.7	----	22	12,693	−56.6	----
150	5	13,689	−57.2	----	26	14,075	−67.4	----	19	13,408	−53.3	----	11	13,981	−65.1	----	25	14,046	−66.3	----	5	13,628	−58.1	----	17	13,660	−57.4	----
125	----	----	----	----	21	15,164	−72.5	----	13	14,606	−55.0	----	6	15,059	−65.6	----	17	15,159	−68.6	----	----	----	----	----	7	14,791	−56.7	----
100	----	----	----	----	----	----	----	----	5	16,055	−55.0	----	----	----	----	----	6	16,464	−73.2	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	El Paso, Tex. (881.9 mb.)				Ely, Nev. (806.1 mb.)				Glasgow, Mont. (945.2 mb.)				Grand Junction, Colo. (851.5 mb.)				Great Falls, Mont. (889.2 mb.)				Greensboro, N. C. (990.4 mb.)				Hatteras, N. C. (1,022.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	1,195	2.2	72	31	1,908	−14.3	76	31	648	−16.8	66	31	1,474	−7.0	73	31	1,128	−11.2	63	21	273	7.5	78	31	3	10.3	87
1,000	31	164	(*)	----	31	232	(*)	----	31	216	(*)	----	31	198	(*)	----	31	213	(*)	----	31	192	(*)	----	31	190	12.7	77
950	31	591	(*)	----	31	638	(*)	----	31	612	(*)	----	31	613	(*)	----	31	620	(*)	----	31	616	9.1	67	31	624	11.6	66
900	31	1,035	(*)	----	31	1,060	(*)	----	31	1,015	−13.5	63	31	1,039	(*)	----	31	1,038	(*)	----	31	1,065	8.6	62	31	1,071	9.6	61
850	31	1,493	2.3	63	31	1,499	(*)	----	31	1,452	−11.5	56	31	1,486	(*)	----	31	1,473	−10.2	53	31	1,537	7.0	61	31	1,543	7.8	60
800	31	1,981	.8	61	31	1,966	(*)	----	31	1,916	−11.4	53	31	1,963	−5.0	63	31	1,939	−11.7	53	31	2,034	5.6	56	31	2,042	6.3	53
750	31	2,503	−1.4	57	31	2,460	−10.3	65	31	2,414	−12.5	50	31	2,472	−7.1	65	31	2,439	−13.0	56	30	2,568	3.6	54	31	2,575	4.0	50
700	31	3,044	−4.2	57	31	2,992	−11.9	58	31	2,934	−14.9	52	31	3,004	−9.8	66	31	2,956	−14.6	56	30	3,119	1.4	50	31	3,127	1.7	47
650	31	3,629	−7.1	54	31	3,562	−14.5	54	31	3,499	−17.6	53	31	3,579	−13.1	67	31	3,522	−17.7	54	30	3,713	−1.6	46	31	3,722	−1.5	46
600	31	4,246	−10.8	47	31	4,150	−18.1	52	30	4,084	−20.9	----	31	4,178	−16.2	64	31	4,108	−21.3	----	30	4,346	−5.0	44	30	4,353	−5.0	46
550	31	4,912	−14.8	44	31	4,805	−22.1	----	30	4,722	−24.8	----	31	4,832	−20.1	60	31	4,746	−25.3	----	30	5,024	−9.1	39	30	5,031	−9.1	40
500	31	5,625	−19.2	40	31	5,499	−26.9	----	30	5,408	−29.3	----	31	5,527	−24.9	----	31	5,430	−30.0	----	30	5,755	−13.9	40	30	5,763	−13.4	35
450	31	6,408	−24.0	----	31	6,256	−31.6	----	30	6,158	−34.6	----	31	6,294	−29.9	----	31	6,182	−35.1	----	30	6,557	−19.3	40	28	6,569	−18.9	38
400	29	7,247	−29.6	----	31	7,076	−37.4	----	30	6,966	−40.2	----	31	7,115	−35.7	----	30	6,975	−40.5	----	30	7,413	−25.7	----	27	7,436	−25.2	----
350	28	8,184	−35.5	----	31	7,987	−43.0	----	28	7,869	−45.8	----	30	8,039	−41.6	----	30	7,874	−45.6	----	29	8,370	−32.6	----	27	8,391	−32.5	----
300	26	9,242	−42.6	----	30	9,023	−47.5	----	28	8,882	−51.2	----	27	9,061	−47.7	----	30	8,889	−50.6	----	29	9,437	−40.5	----	26	9,463	−40.4	----
250	25	10,452	−49.6	----	29	10,213	−51.4	----	23	10,024	−54.0	----	22	10,254	−51.2	----	28	10,064	−53.1	----	28	10,654	−49.8	----	25	10,701	−50.0	----
200	21	11,915	−55.9	----	26	11,640	−52.6	----	20	11,461	−53.7	----	20	11,716	−51.0	----	25	11,481	−52.6	----	26	12,081	−58.1	----	21	12,124	−59.4	----
175	19	12,755	−56.6	----	22	12,515	−52.2	----	19	12,319	−53.8	----	19	12,590	−51.5	----	23	12,327	−52.2	----	25	12,917	−60.0	----	15	12,977	−62.4	----
150	16	13,742	−58.8	----	21	13,511	−52.9	----	15	13,275	−54.1	----	19	13,587	−52.6	----	21	13,322	−52.5	----	17	13,888	−61.1	----	12	13,936	−62.4	----
125	14	14,885	−61.0	----	18	14,679	−54.6	----	14	14,444	−54.8	----	13	14,759	−53.2	----	20	14,490	−54.1	----	9	15,042	−64.0	----	6	15,063	−64.2	----
100	6	16,279	−64.5	----	15	16,099	−56.6	----	8	15,899	−56.1	----	7	16,191	−55.3	----	14	15,961	−54.2	----	----	----	----	----	----	----	----	----
80	----	----	----	----	5	17,572	−58.2	----	5	17,346	−55.0	----	----	----	----	----	7	17,423	−56.1	----	----	----	----	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during January 1949*—Continued

Standard pressure surface (mb.)	Havana, Cuba [1] (.... mb.)				Honolulu, T. H. (1,012.6 mb.)				International Falls, Minn. (975.5 mb.)				Joliet, Ill. (998.4 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	----	----	----	----	31	3	23.1	71	31	360	−14.1	78	31	178	−2.7	82
1,000	----	----	----	----	31	112	22.2	72	31	168	(*)	----	31	163	(*)	----
950	----	----	----	----	31	559	18.5	76	31	563	−13.0	76	31	575	−3.5	78
900	----	----	----	----	31	1,018	15.1	78	31	971	−11.8	67	31	998	−1.8	63
850	----	----	----	----	31	1,500	12.0	74	31	1,410	−10.7	57	31	1,453	−1.0	56
800	----	----	----	----	31	2,007	10.0	58	31	1,875	−11.3	54	31	1,937	−1.8	54
750	----	----	----	----	31	2,545	7.9	48	31	2,380	−12.1	54	31	2,455	−3.3	50
700	----	----	----	----	31	3,107	5.3	37	31	2,895	−14.1	56	31	2,993	−5.5	44
650	----	----	----	----	30	3,712	2.1	30	31	3,465	−16.2	55	31	3,580	−8.2	40
600	----	----	----	----	30	4,352	−1.7	----	31	4,054	−19.6	56	31	4,189	−11.4	37
550	----	----	----	----	30	5,038	−6.2	----	30	4,705	−23.1	----	31	4,857	−15.4	38
500	----	----	----	----	30	5,778	−11.5	----	30	5,394	−27.3	----	31	5,565	−19.9	38
450	----	----	----	----	30	6,582	−17.5	----	30	6,149	−32.2	----	31	6,344	−25.3	----
400	----	----	----	----	30	7,449	−23.9	----	30	6,966	−37.7	----	31	7,184	−31.0	----
350	----	----	----	----	30	8,412	−30.4	----	30	7,874	−43.9	----	31	8,118	−37.4	----
300	----	----	----	----	30	9,491	−37.3	----	30	8,894	−50.0	----	31	9,166	−44.6	----
250	----	----	----	----	30	10,731	−44.9	----	30	10,073	−54.1	----	30	10,363	−51.8	----
200	----	----	----	----	30	12,194	−53.0	----	28	11,493	−54.3	----	29	11,793	−56.6	----
175	----	----	----	----	29	13,047	−56.9	----	28	12,350	−53.7	----	28	12,636	−57.8	----
150	----	----	----	----	29	14,014	−61.1	----	28	13,338	−54.6	----	20	13,610	−57.5	----
125	----	----	----	----	29	15,132	−66.0	----	21	14,521	−54.2	----	13	14,766	−58.9	----
100	----	----	----	----	24	16,472	−70.2	----	15	15,935	−55.3	----	----	----	----	----
80	----	----	----	----	21	17,794	−71.0	----	5	17,324	−56.3	----	----	----	----	----
60	----	----	----	----	18	19,520	−64.3	----	----	----	----	----	----	----	----	----
50	----	----	----	----	17	20,644	−60.1	----	----	----	----	----	----	----	----	----
40	----	----	----	----	12	22,054	−55.2	----	----	----	----	----	----	----	----	----
30	----	----	----	----	5	23,918	−51.8	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Lake Charles, La. (1,020.7 mb.)				Lander, Wyo. (827.4 mb.)				Las Vegas, Nev. (940.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	5	11.8	84	31	1,696	−17.2	69	31	660	0.1	65
1,000	30	176	12.3	78	31	248	(*)	----	31	163	(*)	----
950	30	611	11.6	71	31	648	(*)	----	31	578	(*)	----
900	30	1,059	11.2	66	31	1,060	(*)	----	31	1,012	.6	52
850	30	1,536	10.1	61	31	1,492	(*)	----	31	1,469	−2.1	52
800	30	2,039	8.9	53	31	1,951	−11.3	62	31	1,948	−4.6	53
750	29	2,581	6.8	45	31	2,454	−11.0	56	31	2,460	−6.5	53
700	29	3,140	4.6	30	31	2,975	−12.9	56	31	2,990	−9.5	48
650	29	3,740	1.4	----	31	3,544	−15.1	55	31	3,567	−12.6	42
600	29	4,380	−2.2	----	31	4,140	−18.6	51	30	4,166	−16.0	42
550	28	5,064	−6.4	----	31	4,784	−22.6	----	30	4,819	−20.1	42
500	28	5,805	−11.5	----	31	5,476	−27.3	----	30	5,517	−24.3	----
450	28	6,611	−17.1	----	31	6,231	−32.7	----	30	6,283	−29.4	----
400	28	7,477	−23.5	----	31	7,046	−38.2	----	30	7,108	−35.1	----
350	28	8,438	−31.1	----	31	7,953	−44.0	----	30	8,027	−41.2	----
300	28	9,512	−39.6	----	30	8,967	−50.5	----	29	9,053	−46.5	----
250	28	10,733	−49.3	----	27	10,146	−53.8	----	27	10,253	−50.4	----
200	28	12,160	−59.9	----	21	11,577	−52.9	----	26	11,695	−52.1	----
175	26	12,987	−63.4	----	17	12,449	−52.0	----	24	12,563	−51.6	----
150	24	13,926	−65.3	----	12	13,423	−52.2	----	23	13,567	−52.9	----
125	19	15,034	−67.0	----	----	----	----	----	19	14,731	−55.3	----
100	9	16,397	−70.7	----	----	----	----	----	14	16,155	−57.8	----
80	5	17,752	−71.1	----	----	----	----	----	10	17,580	−58.2	----
60	----	----	----	----	----	----	----	----	----	----	----	----
50	----	----	----	----	----	----	----	----	----	----	----	----
40	----	----	----	----	----	----	----	----	----	----	----	----
30	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	Little Rock, Ark. (1,012.3 mb.)				Mazatlan, Mex. (1,011.7 mb.)				Medford, Oreg. (975.8 mb.)				Merida, Mex. (1,014.6 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	79	6.5	81	31	14	19.7	77	31	401	−0.8	77	31	27	23.7	77
1,000	31	178	6.6	79	31	115	19.2	74	31	204	(*)	----	31	154	23.2	77
950	31	602	6.3	79	31	568	19.1	59	31	618	.9	59	31	602	21.0	75
900	31	1,044	6.7	74	31	1,020	17.5	48	31	1,049	−.9	53	31	1,068	18.0	75
850	31	1,513	6.1	68	31	1,507	14.7	44	31	1,504	−2.7	48	31	1,556	15.0	77
800	31	2,010	5.2	65	31	2,016	11.6	42	31	1,982	−5.1	45	31	2,067	12.5	68
750	31	2,540	3.4	59	31	2,561	8.1	45	31	2,492	−7.5	42	31	2,610	10.1	56
700	31	3,094	1.3	53	31	3,118	4.5	43	31	3,021	−10.2	42	31	3,179	8.3	34
650	31	3,690	−1.7	50	31	3,720	.4	42	31	3,594	−12.8	41	31	3,792	5.8	----
600	31	4,329	−5.3	48	31	4,356	−3.1	39	31	4,195	−16.2	36	31	4,439	2.2	----
550	31	4,998	−9.2	46	31	5,041	−6.6	40	31	4,847	−20.1	34	31	5,135	−1.8	----
500	30	5,733	−13.9	45	31	5,780	−11.2	42	31	5,546	−24.3	----	31	5,886	−7.3	----
450	29	6,531	−19.1	46	29	6,590	−16.2	42	31	6,312	−28.9	----	31	6,702	−13.5	----
400	28	7,392	−25.1	----	29	7,460	−21.8	----	31	7,140	−34.8	----	31	7,582	−20.5	----
350	27	8,350	−31.8	----	27	8,429	−29.0	----	31	8,059	−41.2	----	30	8,552	−28.6	----
300	27	9,420	−40.1	----	28	9,514	−37.1	----	31	9,091	−48.0	----	30	9,634	−37.5	----
250	27	10,636	−49.5	----	26	10,755	−46.4	----	30	10,277	−54.0	----	30	10,865	−47.4	----
200	25	12,067	−57.9	----	25	12,205	−56.9	----	30	11,695	−57.1	----	30	12,303	−58.1	----
175	22	12,885	−60.6	----	24	13,041	−61.4	----	26	12,533	−55.8	----	29	13,134	−63.0	----
150	15	13,820	−59.3	----	20	14,001	−63.5	----	19	13,493	−54.6	----	29	14,072	−67.4	----
125	10	14,941	−60.9	----	9	15,145	−65.8	----	16	14,668	−54.8	----	27	15,158	−72.2	----
100	----	----	----	----	----	----	----	----	10	16,085	−55.8	----	16	16,445	−77.4	----
80	----	----	----	----	----	----	----	----	7	17,548	−56.8	----	----	----	----	----

Standard pressure surface (mb.)	Miami, Fla. (1,021.8 mb.)				Nantucket, Mass. (1,019.1 mb.)				Nashville, Tenn. (1,000.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	4	19.6	78	31	14	2.4	84	31	177	7.6	81
1,000	31	191	20.6	69	31	166	2.5	78	31	182	(*)	----
950	31	633	17.6	71	31	585	1.0	78	31	609	7.4	73
900	31	1,093	14.5	69	31	1,014	−.5	72	31	1,049	6.7	69
850	31	1,575	12.4	59	31	1,468	−1.0	61	31	1,518	5.5	61
800	31	2,083	11.7	33	31	1,953	−1.5	53	31	2,013	4.0	59
750	31	2,624	10.4	----	31	2,471	−2.8	46	31	2,543	2.6	56
700	31	3,192	8.1	----	31	3,011	−5.1	49	31	3,093	.2	51
650	31	3,802	5.0	----	31	3,589	−7.8	49	31	3,686	−3.0	51
600	31	4,448	1.4	----	31	4,209	−11.1	42	31	4,314	−6.2	44
550	31	5,141	−3.1	----	31	4,874	−14.5	39	31	4,993	−9.9	41
500	31	5,890	−8.3	----	31	5,589	−18.8	38	31	5,720	−14.3	42
450	31	6,707	−14.0	----	31	6,370	−24.4	----	31	6,517	−19.5	43
400	31	7,582	−20.9	----	31	7,216	−30.0	----	31	7,376	−25.5	----
350	31	8,554	−28.7	----	31	8,154	−36.4	----	31	8,330	−32.7	----
300	31	9,638	−37.2	----	31	9,206	−43.7	----	31	9,396	−41.1	----
250	30	10,871	−47.1	----	30	10,415	−52.1	----	29	10,621	−50.9	----
200	28	12,310	−57.7	----	29	11,835	−57.6	----	25	12,050	−59.2	----
175	27	13,145	−61.2	----	24	12,686	−57.7	----	22	12,885	−61.6	----
150	24	14,092	−64.9	----	19	13,639	−57.9	----	16	13,838	−62.7	----
125	18	15,192	−68.8	----	13	14,772	−59.7	----	8	14,926	−62.0	----
100	11	16,524	−73.6	----	9	16,177	−60.2	----	5	16,294	−63.5	----
80	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	New Orleans, La. (1,021.3 mb.)				North Platte, Nebr. (919.6 mb.)				Oakland, Calif. (1,019.7 mb.)				Oklahoma City, Okla. (974.5 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	2	14.3	84	29	849	−12.1	77	31	6	5.9	56	31	391	−1.8	73
1,000	31	180	15.4	77	29	197	(*)	----	31	166	6.5	49	31	182	(*)	----
950	31	620	13.7	66	29	599	(*)	----	31	589	4.3	47	31	595	−.9	71
900	31	1,070	12.6	63	29	1,012	−10.4	72	31	1,023	2.1	43	31	1,025	1.9	66
850	31	1,550	11.7	60	29	1,455	−7.8	61	31	1,483	.2	41	31	1,488	3.0	61
800	31	2.055	9.7	58	29	1,929	−5.5	55	31	1,967	−1.6	38	31	1,979	2.0	55
750	31	2,595	7.3	53	29	2,442	−5.3	51	31	2,485	−3.8	34	31	2,503	.4	54
700	31	3,154	4.8	47	29	2,975	−7.2	49	31	3,021	−6.4	32	31	3,049	−2.0	51
650	31	3,756	2.0	36	29	3,556	−10.3	48	31	3,601	−9.5	33	30	3,635	−5.2	51
600	31	4,397	−1.4	----	28	4,164	−13.8	46	31	4,211	−13.4	33	30	4,256	−8.8	51
550	31	5,086	−5.9	----	28	4,824	−18.3	43	31	4,872	−17.6	35	29	4,933	−12.3	45
500	31	5,825	−10.8	----	28	5,525	−23.2	----	31	5,575	−22.3	----	29	5,652	−16.9	43
450	31	6,636	−16.3	----	27	6,307	−28.2	----	31	6,349	−27.3	----	29	6,445	−21.9	----
400	31	7,503	−22.9	----	26	7,149	−33.9	----	31	7,180	−33.3	----	27	7,305	−27.7	----
350	30	8,469	−30.5	----	26	8,072	−40.2	----	31	8,106	−39.4	----	27	8,252	−34.2	----
300	29	9,545	−39.2	----	23	9,115	−46.6	----	31	9,146	−45.9	----	25	9,318	−41.8	----
250	29	10,767	−49.3	----	21	10,317	−52.3	----	30	10,336	−52.7	----	23	10,543	−50.0	----
200	25	12,205	−59.9	----	14	11,693	−55.7	----	30	11,759	−56.2	----	22	11,972	−56.8	----
175	24	13,027	−64.4	----	----	----	----	----	25	12,601	−54.0	----	19	12,812	−58.1	----
150	20	13,972	−65.8	----	----	----	----	----	22	13,596	−54.5	----	14	13,766	−58.9	----
125	15	15,084	−68.3	----	----	----	----	----	22	14,758	−56.5	----	9	14,933	−62.9	----
100	6	16,444	−71.3	----	----	----	----	----	21	16,170	−59.0	----	----	----	----	----
80	----	----	----	----	----	----	----	----	13	17,561	−58.9	----	----	----	----	----

Standard pressure surface (mb.)	Omaha, Nebr. (984.3 mb.)				Phoenix, Ariz. (977.0 mb.)				Pittsburgh, Pa. (975.3 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	308	−7.1	76	31	339	6.4	69	30	382	2.9	76
1,000	31	181	(*)	----	31	147	(*)	----	30	178	(*)	----
950	31	584	−8.4	71	31	572	7.6	53	30	604	2.5	75
900	31	1,003	−5.5	66	31	1,013	4.7	50	30	1,031	1.2	74
850	31	1,453	−3.9	63	31	1,476	1.3	53	30	1,491	1.1	66
800	31	1,932	−3.5	58	31	1,962	−1.8	56	30	1,978	.1	59
750	31	2,446	−4.3	51	31	2,479	−4.5	51	30	2,503	−1.9	56
700	31	2,983	−6.5	47	31	3,013	−7.4	42	30	3,040	−3.8	52
650	31	3,563	−9.8	47	31	3,591	−10.7	40	29	3,633	−5.9	53
600	31	4,172	−13.6	42	31	4,198	−14.3	35	29	4,246	−9.1	56
550	31	4,833	−17.3	40	31	4,855	−18.2	34	29	4,920	−12.8	55
500	30	5,536	−22.1	----	31	5,559	−22.6	----	29	5,635	−17.5	55
450	30	6,306	−27.7	----	31	6,334	−28.1	----	29	6,429	−22.4	----
400	30	7,140	−33.0	----	31	7,161	−33.8	----	29	7,272	−28.4	----
350	30	8,067	−39.0	----	31	8,086	−39.0	----	28	8,219	−35.2	----
300	30	9,109	−45.5	----	31	9,130	−44.9	----	28	9,275	−43.2	----
250	30	10,308	−51.4	----	28	10,332	−50.2	----	28	10,479	−51.7	----
200	22	11,706	−54.1	----	23	11,772	−52.2	----	25	11,901	−58.6	----
175	19	12,562	−55.0	----	21	12,642	−52.5	----	22	12,729	−58.8	----
150	15	13,531	−55.6	----	21	13,635	−53.8	----	13	13,682	−59.6	----
125	9	14,603	−57.7	----	19	14,796	−56.5	----	8	14,794	−59.8	----
100	----	----	----	----	12	16,197	−59.2	----	----	----	----	----
80	----	----	----	----	5	17,606	−59.1	----	----	----	----	----

See footnotes at end of table.

TABLE 1.—*Mean dynamic height (geopotential) in units of 0.98 dynamic meters, temperature in degrees centigrade, and relative humidity in percent, for standard pressures, as obtained by radiosondes during January 1949*—Continued

Standard pressure surface (mb.)	Portland, Maine (1,018.4 mb.)				Rapid City, S. Dak. (904.1 mb.)				St. Cloud, Minn. (981.1 mb.)				San Antonio, Tex. (991.9 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	20	−2.8	78	26	980	−12.7	66	31	317	−12.2	78	31	240	7.5	76
1,000	31	163	(*)	----	26	199	(*)	----	31	168	(*)	----	31	170	(*)	----
950	31	572	−4.0	66	26	601	(*)	----	31	569	−11.0	72	31	601	8.1	72
900	31	994	−5.3	67	26	1,013	(*)	----	31	978	−8.9	61	31	1,044	8.8	73
850	31	1,442	−5.6	57	26	1,455	−7.7	54	31	1,422	−7.7	57	31	1,517	8.4	70
800	31	1,917	−6.4	51	26	1,927	−7.1	52	31	1,893	−8.2	56	31	2,019	7.7	57
750	31	2,428	−7.4	44	26	2,436	−8.1	50	31	2,401	−8.7	50	31	2,555	6.8	44
700	31	2,956	−9.1	43	25	2,965	−9.5	49	31	2,926	−10.6	50	31	3,115	4.2	39
650	31	3,532	−11.4	42	25	3,540	−12.5	50	31	3,499	−13.6	51	31	3,716	.8	35
600	31	4,137	−14.6	38	24	4,146	−15.8	52	30	4,101	−16.9	50	31	4,353	−3.1	34
550	30	4,797	−18.1	37	24	4,800	−20.5	54	30	4,750	−20.7	----	31	5,040	−7.5	37
500	30	5,502	−22.3	----	24	5,493	−25.1	----	30	5,448	−25.0	----	31	5,773	−12.0	36
450	30	6,274	−27.2	----	24	6,261	−30.3	----	30	6,211	−29.9	----	31	6,580	−17.4	39
400	30	7,108	−32.7	----	23	7,079	−36.0	----	30	7,036	−35.6	----	31	7,444	−23.4	----
350	30	8,036	−39.2	----	23	7,994	−42.1	----	30	7,952	−42.0	----	30	8,411	−30.3	----
300	30	9,076	−46.0	----	22	9,024	−48.7	----	28	8,984	−48.1	----	27	9,501	−38.3	----
250	30	10,268	−53.1	----	22	10,207	−53.6	----	24	10,169	−53.8	----	19	10,727	−47.4	----
200	30	11,690	−56.9	----	21	11,637	−54.5	----	9	11,532	−53.5	----	11	12,147	−56.4	----
175	24	12,496	−55.0	----	19	12,476	−53.6	----	----	----	----	----	6	12,948	−56.4	----
150	23	13,468	−55.9	----	17	13,467	−53.2	----	----	----	----	----	----	----	----	----
125	17	14,613	−57.3	----	12	14,643	−53.9	----	----	----	----	----	----	----	----	----
100	10	16,008	−59.1	----	----	----	----	----	----	----	----	----	----	----	----	----
80	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

Standard pressure surface (mb.)	San Juan, P. R. (1,016.0 mb.)				Santa Maria, Calif. (1,010.3 mb.)				Sault Ste. Marie, Mich. (992.2 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	30	15	23.5	76	31	71	6.1	72	30	221	−0.8	75
1,000	30	153	22.8	73	31	155	6.7	66	30	157	(*)	----
950	30	600	19.3	76	31	578	5.2	55	30	562	−7.8	76
900	30	1,062	15.6	79	31	1,015	2.8	51	30	978	−8.1	74
850	30	1,545	12.3	79	31	1,475	.4	48	30	1,421	−8.6	66
800	30	2,052	10.0	67	31	1,960	−.9	41	30	1,891	−9.0	60
750	30	2,591	9.8	36	31	2,481	−3.0	36	30	2,393	−10.3	59
700	29	3,159	8.2	----	31	3,017	−5.8	38	30	2,918	−12.5	57
650	29	3,763	5.3	----	31	3,602	−8.8	38	30	3,489	−14.6	52
600	29	4,415	1.3	----	31	4,210	−12.5	34	30	4,084	−17.5	49
550	29	5,104	−2.9	----	31	4,873	−16.6	----	29	4,730	−21.5	----
500	29	5,856	−7.7	----	31	5,579	−21.4	----	29	5,423	−25.9	----
450	28	6,668	−13.6	----	31	6,358	−26.6	----	28	6,196	−30.5	----
400	27	7,553	−20.2	----	31	7,190	−32.4	----	27	7,018	−35.5	----
350	27	8,528	−27.6	----	31	8,118	−38.7	----	25	7,942	−40.9	----
300	27	9,618	−35.6	----	30	9,168	−45.0	----	18	9,007	−47.3	----
250	25	10,868	−45.0	----	30	10,366	−51.8	----	11	10,230	−54.9	----
200	23	12,324	−55.5	----	28	11,799	−54.5	----	----	----	----	----
175	20	13,165	−61.1	----	26	12,652	−53.6	----	----	----	----	----
150	17	14,114	−66.2	----	26	13,640	−54.4	----	----	----	----	----
125	13	15,206	−71.3	----	20	14,801	−55.9	----	----	----	----	----
100	9	16,511	−75.6	----	17	16,201	−58.7	----	----	----	----	----
80	----	----	----	----	17	17,598	−59.1	----	----	----	----	----
60	----	----	----	----	8	19,411	−58.4	----	----	----	----	----

Standard pressure surface (mb.)	Spokane, Wash. (938.8 mb.)				Swan Island, W. I.[1] (000.0 mb.)				Tacubaya, Mex. (773.8 mb.)				Tampa, Fla. (1,022.0 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	721	−13.1	74	----	----	----	----	31	2,306	14.7	44	30	9	17.2	81
1,000	31	234	(*)	----	----	----	----	----	31	72	(*)	----	30	196	18.4	70
950	31	629	(*)	----	----	----	----	----	31	534	(*)	----	30	638	16.4	66
900	31	1,045	−9.5	68	----	----	----	----	31	1,008	(*)	----	30	1,093	13.7	65
850	31	1,486	−9.7	64	----	----	----	----	31	1,499	(*)	----	30	1,574	11.6	63
800	31	1,954	−10.1	64	----	----	----	----	31	2,024	(*)	----	30	2,079	10.2	46
750	31	2,454	−11.3	57	----	----	----	----	31	2,572	13.6	44	30	2,617	8.4	34
700	31	2,978	−13.6	51	----	----	----	----	31	3,147	9.5	47	30	3,182	6.0	----
650	31	3,542	−16.6	48	----	----	----	----	31	3,762	4.7	52	30	3,790	3.3	----
600	31	4,136	−20.1	48	----	----	----	----	31	4,405	.5	44	29	4,430	−.3	----
550	31	4,778	−23.6	----	----	----	----	----	30	5,103	−3.0	----	29	5,121	−4.8	----
500	31	5,467	−28.2	----	----	----	----	----	30	5,849	−7.6	----	29	5,862	−9.6	----
450	31	6,220	−33.3	----	----	----	----	----	30	6,672	−13.4	----	29	6,675	−15.3	----
400	31	7,034	−38.1	----	----	----	----	----	30	7,546	−20.2	----	29	7,546	−22.2	----
350	31	7,941	−43.7	----	----	----	----	----	30	8,519	−28.3	----	28	8,515	−29.7	----
300	29	8,981	−48.7	----	----	----	----	----	26	9,612	−36.8	----	27	9,593	−38.3	----
250	26	10,139	−52.5	----	----	----	----	----	25	10,849	−46.4	----	25	10,828	−48.4	----
200	21	11,572	−52.9	----	----	----	----	----	24	12,293	−57.4	----	22	12,255	−59.1	----
175	18	12,431	−52.0	----	----	----	----	----	20	13,124	−62.7	----	21	13,090	−63.1	----
150	12	13,419	−51.1	----	----	----	----	----	8	14,052	−67.2	----	20	14,036	−65.9	----
125	10	14,640	−53.0	----	----	----	----	----	----	----	----	----	18	15,124	−69.9	----
100	6	16,094	−53.3	----	----	----	----	----	----	----	----	----	16	16,435	−74.5	----
80	----	----	----	----	----	----	----	----	----	----	----	----	10	17,732	−75.0	----
60	----	----	----	----	----	----	----	----	----	----	----	----	6	19,430	−70.7	----

Standard pressure surface (mb.)	Tatoosh Island, Wash. (1,021.3 mb.)				Toledo, Ohio (997.0 mb.)				Washington, D. C. (1,019.7 mb.)			
	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity	Number of observations	Dynamic height	Temperature	Relative humidity
Surface	31	31	2.3	78	31	191	0.2	81	31	25	5.8	66
1,000	31	201	1.5	70	31	165	(*)	----	31	184	5.3	65
950	31	617	−.9	65	31	579	−1.3	75	31	605	4.2	64
900	31	1,042	−2.5	62	31	1,006	−1.1	66	31	1,041	2.9	65
850	31	1,495	−3.5	53	31	1,463	−.8	57	31	1,504	2.4	63
800	31	1,973	−5.3	46	31	1,947	−1.8	54	31	1,993	1.0	59
750	31	2,482	−7.5	43	31	2,465	−3.3	51	31	2,516	−.3	56
700	31	3,012	−10.3	46	31	3,003	−5.1	50	31	3,061	−2.4	54
650	31	3,581	−13.6	50	31	3,590	−7.6	46	31	3,649	−5.0	55
600	31	4,184	−17.0	49	31	4,202	−11.6	44	31	4,272	−8.0	51
550	30	4,840	−20.1	43	31	4,869	−14.6	41	31	4,943	−12.2	44
500	29	5,539	−24.9	----	31	5,581	−19.4	41	31	5,665	−16.7	43
450	29	6,302	−29.8	----	31	6,365	−24.8	----	31	6,453	−22.0	----
400	27	7,139	−35.2	----	31	7,204	−30.7	----	31	7,304	−28.2	----
350	27	8,057	−41.3	----	31	8,138	−37.4	----	31	8,248	−35.1	----
300	27	9,088	−48.1	----	31	9,185	−45.0	----	31	9,305	−42.9	----
250	27	10,273	−53.6	----	31	10,380	−53.0	----	31	10,510	−51.6	----
200	27	11,698	−55.9	----	31	11,797	−58.7	----	30	11,935	−59.0	----
175	22	12,523	−54.0	----	30	12,630	−59.4	----	29	12,773	−61.3	----
150	20	13,504	−53.8	----	28	13,599	−59.4	----	22	13,721	−60.0	----
125	19	14,670	−53.9	----	21	14,710	−60.0	----	13	14,861	−61.3	----
100	17	16,082	−54.5	----	15	16,080	−60.3	----	5	16,188	−61.5	----
80	14	17,494	−54.4	----	9	17,439	−60.6	----	----	----	----	----
60	7	19,336	−56.7	----	----	----	----	----	----	----	----	----

[1] Data not yet received.

(*) Temperature and relative humidity data for this level are not available or are available only for certain days. See note entitled "Change in Summarization of Radiosonde Data," p. 6, in the January 1946 issue of the MONTHLY WEATHER REVIEW.

NOTE.—All observations scheduled between 0300 and 0500, G. C. T. except at Ciudad Victoria, Mazatlan and Merida, where they are taken near 0200, G. C. T. "Number of observations" refers to those of dynamic height only. (In a few cases temperature or humidity data may be missing for one or more standard pressure surfaces of some observations.) Relative humidity data are not published for standard pressure surfaces having a corresponding mean temperature below −20° C.

Relative humidity data, beginning with October 1, 1948, were computed, and expressed in these tables, on the basis of the vapor pressure over water. Upper air values of relative humidity at levels with temperatures less than 0° C. have formerly been computed and expressed on the basis of the vapor pressure over ice. All relative humidity observations are obtained by electric hygrometer and have been adjusted to compensate for the values occurring below the operating range of the humidity element. For explanation of the adjustment see article entitled "Curve Method for Obtaining Monthly Means of Relative Humidity," p. 241, MONTHLY WEATHER REVIEW, December 1944.

None of the means included in these tables are based on less than 15 observations at the surface or 5 observations at a standard pressure level.

TABLE 2.—*Free-air resultant winds based on pilot balloon observations made near 2200 G. C. T., during January 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Abilene, Tex. (534 m.)			Albuquerque, N. Mex. (1,627 m.)			Atlanta, Ga. (299 m.)			Billings, Mont. (1,095 m.)			Bismarck, N. Dak. (505 m.)			Boise, Idaho (868 m.)			Brownsville, Tex. (7 m.)			Buffalo, N. Y. (220 m.)			Burlington, Vt. (100 m.)			Charleston, S. C. (16 m.)			Cincinnati, Ohio (273 m.)			Denver, Colo. (1,618 m.)			El Paso, Tex. (1,193 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	22	257	2.2	31	156	2.2	26	263	2.4	29	237	3.7	26	303	3.2	30	343	0.7	28	110	1.7	23	255	2.0	26	251	1.2	30	253	1.0	24	233	2.7	27	72	0.8	30	204	1.4
500							26	260	2.6										28	122	2.2	23	240	4.1	26	229	3.3	30	236	3.3	24	221	3.9						
1,000	22	244	4.9				25	249	4.7				26	303	6.3	30	326	1.1	19	166	4.8	15	240	6.3	25	245	5.9	26	258	5.1	19	228	8.0						
1,500	18	249	8.0				22	265	7.6	29	262	6.5	23	299	7.3	30	316	2.9	11	198	7.2	11	266	10.1	18	265	8.9	25	263	7.2	18	242	10.9				30	244	1.6
2,000	18	254	10.7	31	172	2.8	18	275	11.3	28	293	7.7	20	295	10.5	30	325	4.4							14	272	13.2	23	276	7.5	16	247	13.9	27	52	.8	27	243	3.7
2,500	16	250	14.0	31	213	5.1	15	273	12.8	24	292	8.0	16	292	11.9	27	341	4.3							12	274	14.4	22	281	9.7	15	264	16.0	27	224	1.9	23	243	8.6
3,000	15	244	17.4	24	236	13.6	15	270	14.5	24	291	8.8	16	287	12.3	26	353	5.6							11	276	15.9	21	278	12.7	13	271	18.8	25	242	4.0	21	248	11.2
4,000	14	242	23.4	20	247	11.2	14	270	17.3	23	293	8.9	15	284	15.0	22	90	8.0										18	281	15.0	10	271	23.0	24	260	7.3	17	247	16.1
5,000	11	247	29.7	17	247	14.0	12	273	20.1	19	286	8.5	12	267	16.9	21	3	10.3										15	282	19.0				19	259	13.2	15	249	22.1
6,000				16	248	15.1	10	263	21.7	16	316	8.1	10	270	17.1	16	359	10.8										13	290	20.2				15	247	13.7	14	249	25.8
8,000				14	236	24.0																												13	250	15.9			

Altitude (meters) m. s. l.	Ely, Nev. (1,910 m.)			Grand Junction, Colo. (1,475 m.)			Greensboro, N. C. (271 m.)			Havre, Mont. (767 m.)			Jacksonville, Fla. (16 m.)			Joliet, Ill. (178 m.)			Las Vegas, Nev. (663 m.)			Little Rock, Ark. (88 m.)			Medford, Oreg. (416 m.)			Miami, Fla. (11 m.)			Mobile, Ala. (66 m.)			Nashville, Tenn. (182 m.)			New York, N. Y. (15 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	27	14	1.2	28	327	0.4	26	272	1.1	27	266	2.5	27	153	0.9	25	254	2.7	30	340	1.0	22	245	1.6	30	319	0.8	31	104	3.6	24	152	1.7	22	198	2.2	27	317	3.9
500							26	261	2.3				27	214	2.3	25	244	4.0				22	236	3.8	30	315	.7	31	102	5.1	23	169	2.6	22	199	4.8	27	295	4.5
1,000							25	257	6.0	27	267	5.3	27	240	3.5	15	238	8.3	30	344	1.3	18	242	6.1	30	123	.9	31	99	3.9	19	253	1.9	19	211	8.1	22	308	7.2
1,500				28	324	.4	24	268	9.3	27	287	7.0	25	254	3.0	14	250	10.6	29	335	2.5	17	260	8.7	29	79	1.4	31	88	2.6	19	241	3.7	13	237	11.5	21	300	9.1
2,000	27	23	1.3	28	218	.9	23	284	12.6	26	303	7.5	24	271	4.0	13	252	10.8	27	327	3.5	12	260	11.8	27	30	4.3	29	76	2.0	18	245	5.8	11	248	14.6	18	289	12.1
2,500	27	334	2.8	27	203	1.8	21	280	14.5	19	297	6.4	22	284	5.0	12	258	11.7	25	335	3.5	10	255	14.8	25	20	7.8	27	86	2.3	16	248	7.6	10	246	15.1	17	293	14.2
3,000	24	336	3.5	25	223	2.8	21	280	15.2	16	290	6.3	21	273	6.8	10	267	12.5	24	334	3.8				24	10	9.8	24	90	1.1	16	251	10.2	10	254	18.2	11	292	15.0
4,000	17	341	6.5	19	262	3.6	17	280	21.8	13	291	2.6	20	280	9.7				21	340	8.1				22	3	14.3	20	291	2.1	12	252	13.3						
5,000	13	338	7.9	13	307	8.3	14	282	24.5				17	287	10.8				20	349	12.0				20	7	19.8	15	280	6.8	12	248	15.0						
6,000	12	342	8.9	10	322	12.0	13	288	25.6				17	282	14.2				18	341	14.5				13	357	17.7	14	284	8.8									
8,000													10	291	19.9				11	353	19.6							10	270	11.6									

Altitude (meters) m. s. l.	Oakland, Calif. (8 m.)			Oklahoma City, Okla. (396 m.)			Omaha, Nebr. (306 m.)			Phoenix, Ariz. (338 m.)			Rapid City, S. Dak. (982 m.)			St. Cloud, Minn. (318 m.)			St. Louis, Mo. (181 m.)			San Antonio, Tex. (240 m.)			San Diego, Calif. (13 m.)			Sault Ste. Marie, Mich. (221 m.)			Seattle, Wash. (116 m.)			Spokane, Wash. (725 m.)			Washington, D. C. (24 m.)		
	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	30	322	1.7	21	259	4.0	24	285	2.5	31	156	0.9	26	336	4.2	27	282	2.6	19	263	2.2	22	326	0.2	29	251	2.0	23	281	1.2	29	349	0.2	30	66	0.4	27	269	1.6
500	30	3	3.4	21	258	4.5	24	282	2.2	31	185	.7				27	291	3.7	19	256	4.3	22	220	.7	29	259	1.3	23	276	1.3	29	215	.9				27	274	4.0
1,000	30	7	4.6	20	251	7.5	22	279	4.2	31	204	1.7	26	332	4.3	26	293	5.6	16	259	8.1	20	221	2.9	27	320	1.0	18	228	2.0	27	285	.8	30	126	.3	25	276	7.1
1,500	27	8	7.3	17	253	9.4	20	276	5.2	29	205	2.9	26	314	7.8	25	287	7.8	12	265	13.6	18	243	5.6	21	15	1.9	15	282	3.9	24	329	1.8	29	289	2.4	23	286	9.9
2,000	27	10	7.9	17	251	10.1	17	276	7.1	25	208	3.2	23	300	8.7	22	285	9.8	10	267	16.3	17	242	8.4	19	352	2.7	14	283	7.7	26	336	3.5	26	320	4.1	19	287	13.3
2,500	27	7	9.4	15	251	13.4	14	272	11.0	21	223	3.2	22	300	8.1	20	279	11.9				13	250	11.9	18	351	5.6	14	283	9.8	20	345	5.2	20	328	5.3	18	283	15.9
3,000	26	1	10.7	13	246	17.3	13	284	11.6	20	253	5.1	19	298	8.1	18	277	14.0				13	246	14.1	18	335	7.9	12	280	10.7	18	343	6.5	20	344	6.5	18	281	19.1
4,000	26	357	13.7	10	253	21.6	12	279	14.2	19	264	6.2	13	278	10.1	17	283	15.1				10	245	20.5	12	345	13.9	11	282	14.1	14	349	11.7	16	12	10.8	16	277	22.5
5,000	22	351	17.2				12	271	17.7	14	269	7.6	10	261	14.9	14	274	19.4				10	249	24.7	11	345	13.4				12	358	16.8	16	8	15.5	11	280	25.7
6,000	19	354	21.4				12	263	19.7	13	275	8.4				11	275	19.2							11	339	15.4							12	354	17.7			
8,000	10	358	20.9																																				

TABLE 3.—*Free-air resultant winds based on rawin observations made near 0300 G. C. T., during January 1949. Directions given in degrees from north (N=360°, E=90°, S=180°, W=270°). Speeds in meters per second*

Altitude (meters) m. s. l.	Albuquerque, N. Mex. (1,636 m.)			Big Spring, Tex. (774 m.)			Bismarck, N. Dak. (505 m.)			Brownsville, Tex. (7 m.)			Caribou, Maine (191 m.)			Charleston, S. C. (13 m.)		
Altitude (meters) m. s. l.	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	105	1.8	29	123	1.3	31	334	2.6	31	21	0.9	31	258	1.2	31	211	0.7
500										30	126	4.3	31	271	4.5	31	240	3.0
1,000				29	199	2.3	31	328	5.7	30	51	6.8	31	278	6.8	31	244	3.8
1,500				29	220	5.2	31	325	5.3	30	175	8.5	30	278	8.2	31	256	5.0
2,000	31	204	1.8	28	235	8.5	30	315	6.3	30	190	8.6	30	273	10.2	31	262	6.0
2,500	31	222	4.3	27	233	10.4	29	305	7.5	30	199	8.8	28	278	14.5	30	272	7.5
3,000	30	232	6.1	27	234	13.0	29	299	8.6	30	209	9.7	27	277	15.8	30	270	8.8
4,000	30	244	10.9	26	234	20.2	28	277	11.0	30	223	10.4	23	276	17.7	30	273	12.1
5,000	27	249	12.7	25	236	24.9	28	269	11.6	31	223	13.6	19	286	18.9	30	271	16.5
6,000	25	247	14.4	19	225	28.8	27	264	13.1	31	225	16.4	16	291	20.2	27	273	17.6
8,000	16	255	14.5	13	238	33.0	26	257	16.8	29	235	19.3	11	300	22.6	21	283	20.1
10,000	12	255	21.4				24	248	17.6	21	236	18.3				16	291	23.2
12,000							15	245	18.6	15	244	17.8						
14,000																		
16,000																		

Altitude (meters) m. s. l.	Columbia, Mo. (237 m.)			Grand Junction, Colo. (1,473 m.)			Greensboro, N. C. (275 m.)			Hatteras, N. C. (3 m.)			International Falls, Minn. (358 m.)			Little Rock, Ark. (80 m.)			Miami, Fla. (12 m.)		
Altitude (meters) m. s. l.	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed	Observations	Direction	Speed
Surface	31	252	1.1	31	113	0.4	31	295	0.5	31	294	0.7	31	315	0.5	31	356	0.5	31	78	1.9
500	31	235	3.5				31	246	2.8	31	259	4.1	29	235	.4	31	199	2.5	31	100	5.3
1,000	31	252	6.4				31	260	6.6	31	261	5.2	29	240	2.1	31	221	5.9	31	95	4.8
1,500	31	247	8.4	31	106	.4	31	263	9.2	29	284	6.7	29	273	3.6	31	232	8.8	31	90	4.4
2,000	30	250	11.0	31	153	1.1	31	266	11.3	29	283	8.3	29	270	4.8	31	230	11.6	31	92	3.5
2,500	30	252	13.5	31	186	2.5	30	267	14.5	29	278	9.9	27	262	7.0	30	226	12.7	31	102	2.2
3,000	30	250	15.0	31	212	4.2	29	265	16.4	28	282	11.5	27	261	9.6	29	231	14.5	31	105	1.5
4,000	28	250	17.3	31	229	6.5	28	264	17.9	26	286	15.7	27	261	13.5	29	231	20.8	31	270	.5
5,000	25	257	22.7	30	244	8.8	26	273	20.1	26	284	17.9	26	264	17.6	27	229	23.1	30	299	3.7
6,000	23	246	27.5	28	251	10.0	21	276	22.5	24	287	19.2	24	258	21.8	26	228	28.8	30	288	6.0
8,000	17	251	39.3	20	281	9.3	18	277	25.5	21	292	23.4	20	246	28.2	14	231	35.3	28	297	6.8
10,000				12	305	13.7	14	279	32.2	13	295	24.3	12	239	30.0				28	294	8.1
12,000				10	276	14.9							11	255	23.3				24	290	8.6
14,000																			22	278	13.6
16,000																			12	277	12.4

Altitude (meters) m. s. l.	Nantucket, Mass. (13 m.)			Nashville, Tenn. (180 m.)			New Orleans, La. (6 m.)			Oakland, Calif. (8 m.)			Oklahoma City, Okla. (392 m.)			Rapid City, S. Dak. (980 m.)			St. Cloud, Minn. (318 m.)		
Surface	30	289	2.0	31	225	1.2	31	112	1.1	31	20	1.8	30	298	0.9	26	311	2.5	29	295	1.4
500	29	275	4.3	31	220	5.4	31	174	4.2	31	356	4.8	27	260	1.8				31	293	1.3
1,000	28	271	5.8	31	237	8.5	29	193	4.5	31	1	6.6	27	256	5.0	26	306	2.6	31	262	1.4
1,500	28	273	8.4	31	250	11.7	29	214	7.3	31	5	6.8	28	248	7.4	26	313	5.2	30	256	4.2
2,000	28	272	10.7	31	250	13.8	29	224	9.7	31	359	7.1	27	251	9.8	25	305	5.3	30	248	6.4
2,500	28	273	13.7	30	252	15.9	29	226	10.7	31	354	8.8	27	244	11.7	25	275	7.5	29	257	9.0
3,000	28	273	15.3	28	258	17.5	29	228	12.1	30	349	11.0	27	238	14.8	24	264	9.4	29	258	10.1
4,000	27	277	18.3	26	255	20.4	30	231	16.2	30	345	14.9	21	234	21.6	22	261	12.9	28	261	13.9
5,000	25	286	22.3	23	253	25.0	28	236	19.6	28	349	15.6	21	237	21.4	19	256	15.5	28	259	17.2
6,000	22	289	24.7	18	258	26.0	27	242	21.1	25	346	18.6	20	238	26.0	16	245	19.9	25	259	19.1
8,000	12	297	29.0				19	252	18.5	17	354	16.8				12	265	21.1	18	251	20.7
10,000							14	259	19.3	12	350	21.2							10	238	19.3
12,000							12	251	22.2												
14,000																					

Altitude (meters) m. s. l.	San Antonio, Tex. (242 m.)			San Juan, P. R. (28 m.)			Santa Maria, Calif. (72 m.)			Sault Ste. Marie, Mich. (221 m.)			Spokane, Wash. (726 m.)			Tatoosh Island, Wash. (33 m.)		
Surface	31	45	3.1	31	48	4.2	31	58	1.5	30	52	0.8	31	133	0.5	30	92	3.3
500	31	85	2.4	31	53	6.9	31	13	2.3	30	93	.6				28	70	2.1
1,000	31	159	5.0	31	50	7.0	31	15	2.3	30	263	2.5	31	244	.6	28	17	.7
1,500	31	193	7.3	30	45	6.3	31	349	3.3	28	284	4.2	31	330	1.0	28	296	2.1
2,000	31	206	8.7	29	44	5.8	31	336	5.2	28	274	6.8	31	328	4.0	28	308	5.1
2,500	31	219	11.5	29	44	6.1	31	329	8.0	27	271	9.0	31	327	4.6	29	322	7.6
3,000	30	223	23.5	29	38	7.0	31	332	10.2	26	267	11.1	31	332	6.6	28	321	10.2
4,000	30	226	17.7	28	35	5.6	30	333	12.8	22	267	14.4	31	340	8.9	22	318	11.9
5,000	27	232	22.0	28	14	6.4	27	324	11.0	20	260	17.5	28	337	11.8	19	322	13.1
6,000	22	230	25.6	28	10	9.0	25	337	14.5	16	262	23.4	24	341	13.3	16	323	14.1
8,000	12	248	29.0	22	340	9.6	22	346	16.3				13	347	12.9			
10,000				22	297	15.7	16	329	16.3									
12,000				22	276	25.4	12	309	15.2									
14,000				16	288	22.9	11	312	12.7									

NOTE.—Resultants prepared from rawins at high altitudes are biased toward lower wind speeds. Values appearing in this table should therefore be used with caution when the number of observations missing is greater than three. See note following table 3 in the June 1948 issue of the MONTHLY WEATHER REVIEW.

RIVER STAGES AND FLOODS FOR JANUARY 1949

ELMER R. NELSON

River stages during January were above normal in the eastern half of the country except in the Congaree Basin in South Carolina and in the lower portion of the Red Basin in Louisiana. In the western half they were mostly below normal along the West Gulf of Mexico drainage and in the Sacramento and Arkansas River Basins. The greatest positive departure was at Cairo, Ill., where the Ohio River averaged 16.4 feet above normal.

Significant and extensive flooding occurred during the month in the lower portion of the Ohio Basin. The flooding was severe on the central and lower Wabash and White River Basins in Indiana and on the Ohio River below Evansville, Ind. The floods in southeastern Indiana were generally the greatest since 1943 and the highest since 1937 on the White at Petersburg, Ind. Flood stage was exceeded by more than 3 feet on the Ohio River below Louisville, Ky. Record to near-record stages occurred on the upper Tombigbee in Mississippi and on the Black Warrior in Alabama. Heavy rainfall and melting snow caused moderate flooding on the Gila River in southwestern New Mexico.

Streams in the Eastern States remained nearly free of ice throughout January except in the extreme northern portion of New England. In the upper reaches of the Missouri and Mississippi Rivers the ice increased in thickness 10 and 16 inches respectively. It was 28 inches thick at Bismarck, N. Dak. and ranged from 26.5 inches at Minneapolis, Minn., to 1 inch thick at Davenport, Iowa, on the 31st. Near the middle of the month a severe ice gorge formed in the Missouri between Leavenworth and Atchison, Kans. causing near-record stages at Atchison due to backwater. There was some movement of ice in the Kansas River during the last decade of the month with gorging above Lawrence, Kans.

Precipitation during the month was above normal except in the Columbia and Sacramento—San Joaquin Basins in the west and along the south Atlantic and south Gulf of Mexico drainage areas in the east. It was excessive in the central portions ranging up to 6 times normal in the Arkansas Basin in southeastern Kansas. Precipitation was also exceptionally heavy over the lower Gila Basin in southwestern Arizona, averaging nearly 400 percent of normal. In the Missouri Basin the precipitation averaged near 270 percent of normal while in the Columbia and Sacramento—San Joaquin Basins it averaged approximately 40 percent of normal.

Most of the precipitation in the Western and North Central States was in the form of snow which increased the already deep snow cover to record depths at several points in Utah, Wyoming, and Nebraska. The snow was not only abnormally great in depth but also great in areal extent, reaching down into valleys where snow does not often accumulate. One of the most extensive areas of heavy snow ever to occur in this country during a single storm occurred on the 18th. During the 24-hour period ending 12:30 a. m. on the 19th, 3 to 10 inches of snow fell over an area 1,000 miles long and 150 to 200 miles wide extending northeastward from north-central Texas to northeastern Wisconsin. By the 31st, light to heavy snow covered most of the country except along the Coasts and in the extreme south. It was one of the most extensive snow covers of record. The snow-pack in the Columbia Basin on that date ranged from 110 percent of normal in the upper Columbia and Kootenai Drainage Basins in Canada to nearly 250 percent of normal in the Willamette Basin in Oregon.

Atlantic Slope drainage.—Heavy rains at the end of December caused minor flooding in the lowlands along the tributaries of the Saco and Androscoggin Rivers in Maine on the 1st. The Androscoggin reached its highest level since last spring on the 2d when it reached half bankfull stage at Lewiston, Maine.

A flood threat resulted from the heavy rain (1½ to 2 inches) over southern New England on the 5th–6th as it followed so closely the near-record to record floods resulting from the excessive rain (6 to 10 inches) on December 29 to 31 over much of the same area. The only flooding that resulted occurred on the Connecticut River at Hartford, Conn.

Light flooding occurred along the Susquehanna and Chenango Rivers in New York on the 6th–7th due to snow melt and moderate precipitation (0.74 inch) on the 5th–6th. The snow cover averaged nearly 10 inches over the drainage basins. Minor flooding occurred on the Schuylkill River at Reading, Pa., on the 6th due to rainfall averaging 2.26 inches on the 5th–6th.

Moderate to heavy rains on the 5th–6th caused moderate to heavy rises in the Potomac and Rappahannock Basins between the 6th and 7th with some flooding on the Monocacy River at Frederick, Md., for the second consecutive week. The rainfall over the Monocacy averaged 2 inches. Minor flooding occurred in the James River below Scottsville, Va., on the 6th–8th due to heavy rains on the 6th–7th averaging nearly 1.50 inches.

Heavy rains over the headwaters of the rivers in eastern North Carolina during the last two days of December caused minor flooding on the Cape Fear, Neuse, Tar, and Roanoke Rivers. Moderately heavy rains on the 5th–6th caused light flooding in the rivers in South Carolina. The rainfall over the Saluda, Broad, and Wateree River Basins averaged 1.75 inches.

Only minor flooding occurred in the streams in Georgia due to the moderate to heavy rains on the 4th–6th which ranged from 1 inch in the middle and lower Altamaha system to more than 3 inches in the upper Chattahoochee in the East Gulf of Mexico drainage. Light rains occurred almost daily during the last decade with heavy general rains on the 31st but no important rises resulted.

East Gulf of Mexico drainage.—Light flooding occurred on the Chattahoochee at Norcross, Ga., and on the Apalachicola at Blountstown, Fla., from the moderate to heavy rains on the 4th–6th. The rain over the upper Chattahoochee during the 3-day period averaged more than 3 inches. The only loss from the flooding was due to suspension of business along the Apalachicola.

Moderately heavy rains (2 inches) on the 4th–5th caused light flooding in the lower Choctawhatchee River at Caryville, Fla. Rainfall averaging nearly 5 inches over the headwaters of the Cahaba and Coosa River basins in Alabama and 2.5 and 3.5 inches over the Etowah and Oastanaula Basins in Georgia on the 4th–5th caused light to moderate flooding in these drainage basins.

Unusually high and persistent flood stages occurred on the Warrior and Tombigbee Rivers from the heavy rains in northern and western Alabama and northeastern Mississippi on the 3d–5th. The rainfall averaged 7 inches over the Warrior, and 6.8 inches over the Upper Tombigbee. The rivers rose rapidly and the crests exceeded all records during the past 16 years except at Aberdeen, Miss. The situation was most dangerous at Columbus, Miss., as unusually high stages occurred on the Luxapallila Creek which empties into the Tombigbee just

south of the city. Fourteen hundred homes had to be abandoned temporarily at this point.

Heavy rainfall over the headwaters of the Pearl River on the 3d–5th resulted in a near-record stage at Edinburg, Miss., on the 7th. The precipitation averaged 6.57 inches above Jackson, Miss.

Upper Mississippi Basin.—The light flooding on the Pecatonica at Freeport, Ill., and on the Rock at Moline, Ill., was due to rain, snow melt, and local ice gorges.

Moderate to heavy rains over the Meramec Basin on the 17th–19th and again on the 24th caused light to moderate flooding at all points on the Meramec. The rain averaged 1.75 inches during the 1st period and 0.75 inches on the 24th.

Missouri Basin.—Precipitation during the month was above normal in the Missouri Basin except in a small sector in the extreme upper portion. It averaged 268 percent of normal or 1.96 inches over the entire basin. It was the second greatest amount of precipitation in January in the past 60 years. During January 1916 the precipitation averaged 2.16 inches or nearly 300 percent of normal. Temperatures averaged about 9° below normal in the entire basin and about 13° below normal in the upper basin above Bismarck, N. Dak. A summary of the precipitation conditions during January is given in table 1.

TABLE 1.—*Precipitation data for Missouri River Basin, January 1949*

[Based on reports from approximately 75 stations]

Basin or area	January (inches)	Normal (inches)	Excess (inches)	Percent of normal
Upper Missouri (Plains area above Bismarck, N. Dak.)	0.67	0.49	0.18	137
Middle Missouri and tributaries (Bismarck to Sioux City, Iowa)	1.05	.52	.47	202
Missouri, below Sioux City (exclusive of Platte and Kansas)	4.80	1.52	3.28	316
Platte Basin	1.38	.51	.87	271
Kansas Basin	1.91	.61	1.30	313
Entire Missouri Basin	1.96	.73	1.23	268

Ice caused intermittent minor flooding along the upper Missouri and tributaries during the month. The Missouri overflowed at Fort Benton, Mont., flooding several basements. The Madison flooded lowlands near Three Forks, Mont. closing the U. S. highway No. 10 for nearly 2 days and the Beaverhead was in flood near Dillon, Mont. The damage from these floods was minor.

Minor flooding occurred on the lower reaches of the Big Blue River in the vicinity of Randolph, Kans., and along the Kansas River near Lecompton, Kans., during the last decade due to ice gorges caused by the warm rain on the 22d–23d together with the above freezing temperatures.

The light flooding on the Osage in Missouri was due to moderately heavy rains on the 17th–19th and the 24th.

Ohio Basin.—Precipitation occurring mostly as rainfall during January in the Ohio River Basin produced monthly totals which exceeded the maximum of record at some stations and the greatest since the record flood month of January 1937 at many others. The greatest monthly totals occurred in southern Indiana and southwestern Ohio. At Cincinnati, Ohio, the total for the month was 9.6 inches which although considerably less than the record monthly amount of 13.68 inches recorded in January 1937 was greater than the second previous highest amount (9.49 inches) recorded in January 1876. Most of the flood-producing rain occurred during three major periods, 3d to 6th, 16th to 19th and 21st to 28th, which were sufficiently spaced to allow the peak flows to subside before the next heavy rain occurred.

Slight flooding occurred in the lower portion of the Monongahela River from Lock 5, Brownsville, Pa., to Lock, 2, Braddock, Pa., on the 27th from the rain during the latter period. The amount of run-off during this period was considerably less than normally experienced under similar circumstances. Navigation was interrupted on the middle and lower reaches of the Monongahela and the dams on the Ohio River were lowered below Pittsburgh. Pool stage was exceeded at Pittsburgh during the last 7 days of the month.

Flood stage was slightly exceeded on the Hocking River from the 28th–29th due to the rain from the 21st–28th that averaged over 3 inches. Only slight damage resulted from flooded basements and closed roads.

The heavy rains caused the Scioto River to exceed bank-full stage during the 1st and last decade of the month. The damages from the overflows were negligible as far as crop land and private property were concerned but caused some inconvenience to the traveling public as numerous low places on highways were covered for some time.

Moderately heavy rains on the 4th–6th resulted in flooding on the Whitewater at Brookville, Ind., and on the Little and Great Miami Rivers for a short period beginning on the 5th. The precipitation averaged 4.28 inches on the Whitewater at Brookville, Ind., 2.4 inches on the Little Miami at Kings Mills, Ohio, and 4.85 inches on the Great Miami at Middletown and 2.79 inches at Pleasant Hill, Ohio.

Flood stages were reached on the Green River twice during the month from the moderately heavy rains on the 4th–5th and the 22d–28th. The rainfall averaged 1.9 inches during the 1st period and 3 inches during the latter. The flood losses were negligible.

Floods in the lower Wabash and the entire White River Basins in Indiana were among the highest of record. The most severe flooding occurred on the East and West Forks of the White, the main White and the Wabash from Vincennes, Ind., to the mouth. This severe flooding was due to frequent heavy rains beginning on the 3d, followed by two other major rains and several less important ones with the last important one occurring on the 24th–25th. The heaviest rains occurred along the East Fork and the main branches of the White. The storm of the 3d–5th produced rainfall in excess of 4 inches with 5.79 inches measured at Columbus, Ind., in the headwaters of the East Fork. On the 16th–19th, the rainfall averaged nearly 2 inches in the East Fork and on the 24th–25th in excess of 5 inches over the lower East Fork and main branch of the White River and 1 inch in the headwaters of the Wabash and West Fork of the White. Several stations in the basins reported monthly totals in excess of 12 inches. Petersburg, Ind., at the junction of the East and West Forks reported a monthly total of 15.51 inches. Most of the smaller streams receded below flood stage between storms but the lower portions of the main rivers remained above bank-full stage from the beginning of the heavy rains on the 3d beyond the end of the month. The relative severity of these floods compared with previous ones is given in table 2.

Flood stages were exceeded in the Cumberland Basin from the 6th–15th due to the heavy precipitation (4 inches) on the 3d to the 5th. Some flooding occurred again in the lower portion at Eddyville, Ky., from the 27th through the first week in February due to the heavy rain during the last decade of the month.

TABLE 2.—*Comparative crests for selected stations in southeastern Indiana*

River and station	March 1913	January 1937	March or May 1943	January 1949
EAST FORK OF WHITE	*Feet*	*Feet*	*Feet*	*Feet*
Columbus, Ind	17.9	15.1		14.7
Seymour, Ind	23.0	19.5	19.8	19.7
Shoals, Ind	42.2	37.0	31.4	31.2
WEST FORK OF WHITE				
Spencer, Ind	28.5	23.2		20.1
Elliston, Ind	31.3	26.5	30.0	26.6
Edwardsport, Ind		20.8	25.0	24.1
WHITE				
Petersburg, Ind	29.5	28.1	24.3	25.5
Hazleton, Ind	29.6	31.6	26.3	27.9
WABASH				
Terre Haute, Ind	31.3	21.3	30.5	20.6
Vincennes, Ind		24.8	29.0	23.9
Mount Carmel, Ill	31.0	27.0	27.5	25.9

The second flood-producing rain of the current winter season over the Tennessee River Basin occurred from the 3d to 6th. The heaviest rain (4.5 inches) fell over the main river and tributaries below Chattanooga, Tenn. The rain was especially heavy over the area draining into the Tennessee between Guntersville Dam and Pickwick Dam, averaging 6.6 inches over the area. The storm was not severe over the upper half of the Basin. A new crest record was established on Big Nance Creek at Courtland, Ala., which had slightly more than 8 inches of rain during the 4-day period. The Elk River crested at a near record stage of 27.1 feet at Fayetteville, Tenn., 0.4 foot below the record stage of 27.5 feet. Flash floods occurred at Huntsville, Ala., and Knoxville, Tenn., from the flooding of small creeks flowing through the cities. Only minor damage occurred from the flash floods. On the Elk River, the greatest damage occurred at Fayetteville, Tenn., where 50 families were affected. Light damage occurred along the Duck River, except at Shelbyville, Tenn.

Light flooding occurred at Florence, Ala., on the 24th–25th from the heavy rain over the western and central portions of the Tennessee Basin on the 21st–23d, averaging 1.75 inches below Chattanooga, Tenn.

There were two periods of flooding on the lower Ohio at and below Newburgh, Ind. The first flood was due to heavy rains which occurred over the Tennessee and Ohio Valleys from the 2d to the 5th. The precipitation averaged 2.4 inches along the Ohio Valley below Cincinnati, Ohio, and about 3 inches over the Tennessee during this 4-day period. This flood was a minor one and caused little property damage or inconvenience to the public. The flooding in the reach from Dam 51 to Dam 52 compares closely to the flood of February–March 1948 and in the reach below to that of March–April 1948.

After the passage of the crest, the Ohio fell for 1 week before the third period of heavy precipitation began. The rain from the 21st to the 28th ranged from about 3.5 inches in the upper Ohio to about 7.2 inches in its lower reaches. The greatest 24-hour amount of precipitation on record at Cairo, Ill., occurred on the 23d–24th when 6.09 inches was measured. These rains produced the second flood on the Ohio which extended downstream from Point Pleasant, W. Va., to its mouth, a distance of 716 miles. Bank-full stage was reached but not exceeded at Marietta, Ohio. Flooding was severe in the reach below Evansville, Ind., a distance of 189 miles. Crest stages attained in this flood have often been exceeded and were considerably below the record stages established in 1937.

Four lives were lost during the high water as an indirect result of the flood. Flood damage in the basin was light and consisted mostly of crop losses.

Arkansas and Red Basins.—There were two periods of minor flooding in the Arkansas Basin during the month. Most of the overflows were due to light rain falling on a snow and sleet cover except those in the Poteau and lower Arkansas Basins. The flooding in the Poteau Basin was due to heavy rainfall (8.3 inches) that occurred over the basin below the Wister Reservoir from the 24th–28th. During this 5-day period 11.05 inches was recorded at Poteau, Okla. In the Arkansas Basin between Muskogee, Okla., and Van Buren, Ark., 6 inches of rain was recorded during this storm with the heaviest rain (9 inches) occurring in the lower portion. No major damage resulted from the flooding.

The major flooding that developed in the Red Basin during the latter part of the month extended into February. The flood in the Little River approached within 0.9 foot of the record stage established at Whitecliffs, Ark., in August 1915, and was due to rains averaging 7 inches over the basin from the 23d–25th. Several stations reported storm totals in excess of 10 inches.

The flooding in the Sulphur Basin was due to rains that averaged between 4.75 and 5.25 inches during the same period with 1.5 to 2.5 inches additional on the 26th. The crest at Hagansport, Tex., approached within 2.6 feet of the record stage of 44.7 feet established May 1941.

The flooding on the Red River was due to rains similar in amounts to those over the Little and Suphur.

Lower Mississippi Basin.—Light flooding occurred in the St. Francis River from the 7th to the 14th, due to moderate rains on the 3d–5th averaging 1.5–1.75 inches. Moderate flooding developed during the last decade and continued into February. This flooding was due to heavy rain averaging nearly 5 inches over the basin from the 22d to the 28th.

Moderate to severe flooding developed in the Yazoo-Tallahatchie Basins in Mississippi from the heavy rains on the 2d–5th. The rain averaged 5–9 inches over the southeastern half and 2–5 inches over the northern quarter of the basin. The heaviest rain (9 inches) occurred over the Yalobusha at Grenada, Miss., and over the Yazoo in the vicinity of Greenwood, Miss. Abnormally high stages occurred in these rivers prior to this storm from the heavy rains during the latter part of November. The crests in the Tallahatchie–Yazoo Rivers ranged from 4 to 6 feet above bank-full stage. The crest of the Yazoo at Greenwood, Miss., approached within 1.2 feet of the record stage of 40.1 feet of January 1932. Light flooding occurred on the Coldwater at Sarah, Miss., on the 3d–4th. Two periods of flooding occurred on the lower Mississippi at New Madrid and Caruthersville, Mo. The first was due mainly to the high water from the Ohio resulting from the heavy rains on the 2d to the 5th. The other was due to moderate rains (1.5 inches) over the upper Mississippi on the 23d–28th and the high water from the Ohio.

West Gulf of Mexico drainage.—Minor flooding occurred in the headwaters of the Sabine Basin in Texas due to the heavy rain (4 inches) on the 24th–27th. Damage was negligible.

Very little run-off occurred from the light rains on the 9th–18th over the upper Trinity Basin in Texas as it followed one of the worst dry spells of recent years in that section. It, however, thoroughly moistened the soil and set the stage for the moderate flooding that followed the rains that occurred during the period from the 21st to the 30th. The rain averaged 4.63 inches in the upper Trinity

Basin during the week of the 22d to the 28th. Flash floods occurred in the smaller tributaries of the Trinity River System from the heavy downpours of rain that occurred during the night of the 23d–24th. No damage of consequence occurred.

Colorado Basin.—Moderate flooding occurred in the upper Gila River in New Mexico during the 13th–14th. This flooding was due to rapid snow-melt accompanied by light rain (0.5 inch) at lower elevations and heavy rain (1–2 inches) at higher elevations. The snow pack was quite extensive over the mountainous regions in the upper basins and ranged from 2–4 feet in depth prior to the 13th as 3 to 4 inches of precipitation occurred during the last week of December and the 1st decade of January and occurred mostly as snow above the 4 thousand foot level. The high waters that exceeded flood stage by 4.6 feet at Cliff, N. Mex., approached within 1.2 feet of the record stage of 13.8 feet that occurred in September 1941. Thirty-nine hundred acres of land was inundated along the Gila River but very little damage resulted as most crops had been harvested. Bridges at Virden, N. Mex., and Pima, Ariz., were damaged.

Pacific slope drainage.—Minor flooding occurred in the Imperial and Colorado River Valleys in southern California with more serious flooding in the Sonora Province of Mexico following the locally moderate rains of the 10th–13th.

The month of January was one of the coldest of record in the Sacramento Basin and precipitation was in the form of snow in the foothills and mountains. The streams continued unusually low for the winter season as there was no melting due to the continuously cold weather. The American River near Sacramento, Calif., was frozen over with thin ice on the 11th which is very rare in the Sacramento Valley.

The Eel River in California was the lowest of record for an entire month during the winter season. Rainfall over the basin was also the lowest on record for January.

Ice jams formed in the Columbia Basin on the Salmon below Challis, Idaho, and on the Big Wood near Hailey, Idaho, causing some overflow over adjacent highways. There was considerable ice in the Columbia River with barge lines operating upstream only as far as The Dalles, Oreg., during the last half of the month. In the Willamette River, there was considerable ice in the lower portion above Oregon City, Oreg., but very little in the middle and upper portions.

FLOOD STAGE REPORT FOR JANUARY 1949

[All dates in January unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ST. LAWRENCE DRAINAGE	Feet			Feet	
Lake Erie					
St. Marys: Decatur, Ind.	13	10	11	14.0	11
		19	22	15.1	19
		28	29	15.6	28
St. Joseph: Montpelier, Ohio	10	7	8	10.5	8
		20	22	11.7	21
Maumee:					
Fort Wayne, Ind.	15	19	21	16.7	19
		28	29	15.8	28
Defiance, Ohio	10	20	20	10.0	20
ATLANTIC SLOPE DRAINAGE					
Connecticut: Hartford, Conn.	16	7	8	16.0	8
Schuylkill: Reading, Pa.	13	6	6	13.1	6
Tioughnioga: Whitney Point, N. Y.	12	6	6	12.2	6
Chenango:					
Sherburne, N. Y.	8	6	6	8.7	6
Greene, N. Y.	8	7	7	8.6	6
Susquehanna:					
Oneonta, N. Y.	12	6	7	14.2	6, 7
Bainbridge, N. Y.	13	6	7	14.4	7
Vestal, N. Y.	16	7	7	17.5	7
Monocacy: Frederick, Md.	15	6	7	16.0	6

See footnotes at end of table.

FLOOD STAGE REPORT FOR JANUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
ATLANTIC SLOPE DRAINAGE—con.					
James:					
Bremo Bluff, Va.	19	7	7	19.0	7
Columbia, Va.	18	6	8	20.2	6
				19.6	7
State Farm, Va.	12	7	7	13.6	7
Richmond, Va.	8	7	8	8.3	7
Roanoke:					
Alta Vista, Va.	10	Dec. 30	Dec. 31	----	----
		6	7	18.3	6
Randolph, Va.	21	Dec. 31	1	23.2	1
Weldon, N. C.	31	1	3	37.3	2
		8	9	35.3	9
Scotland Neck, N. C.	28	3	4	30.6	3
		10	10	30.1	10
Williamston, N. C.	10	2	20	11.3	7–9, 13–14
Tar: Tarboro, N. C.	18	3	3	18.3	3
Neuse:					
Neuse, N. C.	14	Dec. 31	3	16.2	2
		8	8	14.1	8
Smithfield, N. C.	13	Dec. 31	4	15.9	3
		8	10	13.8	9
Goldsboro, N. C.	14	3	12	16.1	7
Kinston, N. C.	14	6	12	14.9	9–10
Cape Fear: Elizabethtown, N. C.	20	1	4	27.5	2
		8	10	24.1	8–9
Pee Dee:					
Cheraw, S. C.	30	7	8	35.4	7
Pee Dee, S. C.	19	1	16	22.7	12
Saluda:					
Pelzer, S. C.	6	6	9	8.0	6
Chappells, S. C.	13	7	9	16.1	8
Broad: Blairs, S. C.	14	6	8	18.6	7
Wateree: Camden, S. C.	23	7	8	24.5	7
Edisto: Givhans Ferry, S. C.	10	Nov. 29	Dec. 31	14.6	Dec. 3
Broad: Carlton, Ga.	15	16	16	16.6	16
Savannah: Butler Creek, Ga.	21	7	9	23.4	8
Ogeechee: Dover, Ga.	7	6	16	7.5	9
Ocmulgee: Abbeville, Ga.	11	4	10	11.8	7
Oconee: Mount Vernon, Ga.	16	6	9	16.5	7
Altamaha: Charlotte, Ga.	12	1	21	16.3	9, 10
EAST GULF OF MEXICO DRAINAGE					
Chattahoochee: Norcross, Ga.	16	7	7	20.2	7
Apalachicola: Blountstown, Fla.	15	Dec. 1	([3])	23.6	Dec. 6
				20.6	11
Choctawhatchee: Caryville, Fla.	12	9	10	12.4	9
Oostanaula:					
Resaca, Ga.	22	6	10	27.6	8
Rome, Ga.	25	6	10	27.8	7
Etowah:					
Canton, Ga.	17	6	7	21.5	6
Cartersville, Ga.	18	6	7	20.5	6
Coosa:					
Gadsden, Ala.	20	5	15	27.8	7
Childersburg, Ala.	20	5	7	25.2	7
Cahaba:					
Centerville, Ala.	23	5	8	32.0	5
Marion Junction, Ala.	36	8	10	38.3	9
Alabama:					
Montgomery, Ala.	35	6	12	43.4	9
Selma, Ala.	45	10	11	45.8	11
Millers Ferry, Ala.	40	8	17	47.9	13
Black Warrior:					
Tuscaloosa Lock and Dam, Ala.	47	5	9	64.4	6
Lock No. 7, Eutaw, Ala.	35	6	30	54.6	10
Tombigbee:					
Aberdeen, Miss.	34	4	11	43.2	6
		23	28	38.8	24
Columbus, Miss.	29	5	12	30.3	7
		24	28	31.4	25–26
Gainesville, Ala.	36	7	([3])	53.7	11
Lock No. 4, Demopolis, Ala.	39	9	([3])	65.2	14
Lock No. 3	33	Nov. 21	([3])	61.5	16
Lock No. 1	31	6	([3])	43.8	20
Pearl:					
Edinburg, Miss.	20	Nov. 27	12	26.0	Dec. 1
				26.0	7
		21	20	23.8	24
Jackson, Miss.	18	Nov. 20	([3])	32.9	Dec. 6
				33.1	12
				30.5	26
Monticello, Miss.	15	5	([3])	20.8	7
				22.9	20
Columbia, Miss.	17	7	([3])	19.7	11
				22.4	23
Pearl River, La.	12	Nov. 24	([3])	16.7	Nov. 30
				15.0	15
				15.8	27
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Pecatonica: Freeport, Ill.	10	6	10	10.3	6, 9
		17	20	10.9	17
Rock: Moline, Ill.	10	17	17	10.0	17
Meramec:					
Sullivan, Mo.	11	19	20	13.6	19
		25	26	13.8	26
		29	29	11.5	29
Pacific, Mo.	11	20	21	14.3	21
		25	30	15.2	26
				13.2	30
Valley Park, Mo.	14	20	22	17.1	21
		26	30	19.4	27
				16.2	30

FLOOD STAGE REPORT FOR JANUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Missouri Basin					
Big Blue: Randolph, Kans	22	24	25	22.3	24
Kansas: Lecompton, Kans	17	24	24	17.8	24
Osage:					
Warsaw, Mo	31	24	26	31.8	24, 25
Lakeside (Bagnell Dam), Mo	60	24	Feb. 1	61.1	25
Ohio Basin					
Monongahela:					
Lock No. 5 (lower gage), Brownsville, Pa	29	27	27	29.6	27
Lock No. 4 (upper gage), Charleroi, Pa	24	27	27	25.2	27
Lock No. 3 (lower gage), Elizabeth, Pa	26	27	27	27.3	27
McKeesport, Pa	12	27	27	12.4	27
Lock No. 2 (upper gage), Braddock, Pa	22	27	27	22.6	27
Muskingum: Lock No. 1, Marietta, Ohio	35	29	29	35.0	29
Hocking:					
Enterprise, Ohio	12	28	28	13.0	28
Athens, Ohio	17	29	29	17.2	29
Elk: Clay, W. Va	16	28	28	16.0	28
Scioto:					
La Rue, Ohio	11	5	6	12.5	6
		27	29	11.3	27, 28
Prospect, Ohio	10	7	8	11.0	7
		29	29	10.3	29
Circleville, Ohio	14	6	7	18.0	7
		25	30	17.8	29
Chillicothe, Ohio	16	7	8	17.3	7
		26	26	16.0	26
		28	30	18.5	30
Piketon, Ohio	15	6	9	20.0	7
		25	31	22.5	29
Little Miami: Kings Mills, Ohio	17	5	5	20.0	5
Stillwater: Pleasant Hill, Ohio	13	5	6	16.0	5
Whitewater: Brookville, Ind	20	5	6	24.2	5
Miami: Middletown, Ohio	15	5	7	16.4	6
Green:					
Bowling Green, Ky	28	6	8	30.2	7
Lock No. 4, Woodbury, Ky	33	7	11	37.7	8
		25	31	36.6	29
Lock No. 2, Rumsey, Ky	34	9	15	36.4	12
		25	31		
West Fork:					
Muncie, Ind				9.7	5
Anderson, Ind	10	5	7	16.2	6
		19	20	13.4	19
		28	29	11.6	28
Noblesville, Ind	14	7	8	14.9	7
		20	20	15.0	20
Indianapolis, Ind	12	20	20	12.0	20
Spencer, Ind				20.1	6
Elliston, Ind	18	1	2	19.6	1
		5	12	25.4	8
		18	(2)	26.6	23
Newberry, Ind				21.2	24
Edwardsport, Ind	12	Dec. 30	(2)	17.8	2
				24.1	25
East Fork:					
Columbus, Ind				14.7	6
Seymour, Ind	14	5	9	19.7	5
		19	30	18.0	25
Bedford, Ind				32.5	8
Williams, Ind	10	7	13	20.4	9
		23	(2)	18.7	28
Shoals, Ind	25	9	13	31.2	10
		25	(2)	30.5	29
White:					
Petersburg, Ind	16	4	(2)	25.5	26
Hazleton, Ind	16	4	(2)	27.9	27
Wabash:					
Bluffton, Ind	10	7	8	10.0	7, 8
		18	21	11.0	18
Wabash, Ind	12	5	8	17.0	5
		19	22	20.1	19
		27	30	17.6	28
La Fayette, Ind	11	1	1	13.2	1
		6	13	18.6	7
		18	(2)	21.7	20–21
Covington, Ind	16	1	2	17.6	1
		6	14	21.2	9
		19	(2)	25.0	22
Terre Haute, Ind	14	5	(2)	20.6	23
Hutsonville, Ill				24.5	25
Riverton, Ind				21.9	26
Vincennes, Ind	16	7	(2)	23.9	27, 28
Mt. Carmel, Ill	17	5	(2)	25.9	28
New Harmony, Ind	15	7	(2)	22.0	29
Cumberland:					
Williamsburg, Ky	19	6	7	20.8	7
Burnside, Ky	50	6	6	51.7	6
Celina, Tenn	40	6	9	41.6	9
Lock F, Eddyville, Ky	50	8	15	52.5	13
		27	Feb. 7	57.0	31
First Creek: Knoxville, Tenn	5	5	6	7.4	5
Richland Creek: Dayton, Tenn	8	5	5	8.2	5
South Chickamauga Creek: Chickamauga, Tenn	10	4	7	18.9	6
Elk: Fayetteville, Tenn	18	4	8	27.1	5
Duck: Shelbyville, Tenn	21	4	7	30.8	6
Columbia, Tenn	32	6	8	35.8	8
Tennessee:					
Gilbertsville, Tenn	34	5	31	49.0	30
Savannah, Tenn	39	5	14	45.6	10

FLOOD STAGE REPORT FOR JANUARY 1949—Continued

River and station	Flood stage	Above flood stages—dates		Crest [1]	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Ohio Basin—Continued					
Tennessee—Continued		3	13	25.9	8
				19.7	13
Florence, Ala	18	22	22	19.3	22
		24	25	19.3	24
Ohio:					
Point Pleasant, W. Va	40	28	31	42.1	29
Dam No. 29, Ashland, Ky	51	30	30	51.0	30
Dam No. 30, near Greenup, Ky	52	30	30	52.0	30
Portsmouth, Ohio	50	30	31	50.7	30
Dam No. 33, near Maysville, Ky	50	30	Feb. 1	51.6	31
Dam No. 34, Chilo, Ohio	49	30	31	49.9	30
Dam No. 35, New Richmond, Ohio	48	29	Feb. 1	49.2	31
Cincinnati, Ohio	52	28	Feb. 1	52.6	30
Dam No. 37, Fernbank, Ohio	50	28	Feb. 1	52.5	29
Dam No. 38, near Grant, Ky	51	29	31	51.8	29
Dam No. 41, Louisville, Ky.:					
Upper gage	28	28	Feb. 1	29.6	29
Lower gage	55	28	Feb. 1	56.4	29
Dam No. 43, Evans Landing, Ind	57	29	Feb. 1	58.0	29–30
Dam No. 44, Leavenworth, Ind	53	27	Feb. 4	57.8	30
Dam No. 45, Addison, Ky	47	28	Feb. 4	50.5	31
Tell City, Ind	38	27	31	43.7	31
Dam No. 46, Owensboro, Ky	41	29	(2)		
Dam No. 47, Newburgh, Ind	38	9	13	38.6	11
		26	(2)		
Evansville, Ind	42	30	(2)		
Dam No. 48, near Henderson, Ky	38	27	(2)		
Mount Vernon, Ind	35	10	15	36.2	13
		26	(2)		
Dam No. 49, Uniontown, Ky	37	10	17	38.7	13
		26	(2)		
Shawneetown, Ill	33	7	(2)	38.8	14
Dam No. 50, Fords Ferry, Ky	34	7	(2)	41.7	15
Dam No. 51, Golconda, Ill	40	12	17	40.7	14
		27	Feb. 13	48.5	Feb. 4
Paducah, Ky	39	9	19	41.8	13
		24	Feb. 13	46.1	Feb. 4
Dam No. 52, Brookport, Ill	37	7	21	43.5	13
		22	Feb. 12	48.0	30
Dam No. 53, near Mound City, Ill	42	7		47.7	15
				52.6	30
Cairo, Ill	40	9		44.4	16
				50.5	31
Arkansas Basin					
Little Arkansas: Sedgwick, Kans	18	23	25	22.5	23
Verdigris:					
Independence, Kans	30	16	16	30.2	16
Inola, Okla	41.5	25	28	43.0	26
Cottonwood: Emporia, Kans	20	16	17	21.4	17
		24	26	22.4	25
Neosho:					
Emporia, Kans	20	16	17	24.0	16
		24	25	24.8	24
Oswego, Kans	17	16	18	18.6	17
		24	26	18.6	25
Poteau: Poteau, Okla	21	24		30.5	25
Arkansas: Van Buren, Ark	22	28	22	22.0	28
Red Basin					
Little:					
Horatio, Ark				35.6	27
Whitecliffs, Ark	25	26		31.1	28
Sulphur:					
Hagansport, Tex	38	25		42.1	28
Naples, Tex	22	27		30.8	30
Red:					
Fulton, Ark	25	27		32.0	30
Garland, Ark	25	28		29.9	31
Lower Mississippi Basin					
St. Francis:					
Fisk, Mo	20	7	9	20.5	8
		20	(2)	23.8	27–29
St. Francis, Ark	18	11	14	18.4	12–13
		22	(2)	22.6	28–29
Coldwater: Sarah, Miss	18	3	4	19.0	3
Tallahatchie: Swan Lake, Miss	26	4	(2)	30.5	9–10
Yazoo:					
Greenwood, Miss	35	7	(2)	38.8	12
Yazoo City, Miss	29	3	(2)	35.0	31
Mississippi:					
New Madrid, Mo	34	14	20	34.8	17
		25		39.6	Feb. 1
Caruthersville, Mo	32	15	21	32.8	17–18
		26	(2)		
Atchafalaya Basin					
Atchafalaya: Atchafalaya, La	25	17	(2)		
WEST GULF OF MEXICO DRAINAGE					
Sabine: Mineola, Tex	14	28	Feb. 4	17.7	30
East Fork: Rockwall, Tex	10	24	31	17.0	28
Trinity:					
Dallas, Tex	28	24	25	30.9	25
Rosser, Tex	26	27	31	31.0	29
Trinidad, Tex	28	29	Feb. 3	34.0	Feb. 1
GULF OF CALIFORNIA DRAINAGE					
Colorado Basin					
San Francisco: Clifton, Ariz				15.3	13
Gila:					
Cliff, N. Mex	8	13	14	12.6	14
Virden, N. Mex				17.4	14
Safford, Ariz				13.1	14

[1] Provisional.

[2] Continued at end of month.

CLIMATOLOGICAL DATA FOR JANUARY 1949

CONDENSED CLIMATOLOGICAL SUMMARY OF TEMPERATURE AND PRECIPITATION BY SECTIONS

[For description of tables and charts, see Review, January 1948, p. 15]

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Section	Temperature								Precipitation					
			Monthly extremes								Greatest monthly		Least monthly	
	Section average	Departure from the normal	Station	Highest	Date	Station	Lowest	Date	Section average	Departure from the normal	Station	Amount	Station	Amount
	°F.	°F.		°F.	°F.		°F.		In.	In.		In.		In.
Arizona	33.1	−8.3	Florence	75	22	Maverick	−33	4	3.06	+1.78	Crown King	12.50	Petrified Forest	0.50
Arkansas	42.1	+1.0	Pine Bluff	82	10	Gravette	−3	30	10.16	+5.81	Lurton	15.58	Gravette	4.18
California	34.5	−9.7	Yorba Linda	79	6	Boca	−38	25	2.30	−1.65	Crestline	16.82	Inyokern	.05
Colorado	15.8	−8.0	Florence	66	8	Kremmling	−41	19	1.48	+.68	Wolf Creek Pass, 4 W	10.65	Kremmling	.10
Idaho	6.9	−16.8	5 stations	45	[1]1	Chilly, 4 SE	−42	25	1.00	−1.01	Island Park Dam	2.76	Nampa	.02
Illinois	29.8	+2.0	Harrisburg	71	15	Freeport	−23	20	5.96	+3.63	Cairo WB City	13.16	Wheaton College	2.40
Indiana	34.7	+5.7	2 stations	70	18	La Porte	−9	30	7.81	+4.85	Oolitic Purdue Experiment Farm.	14.25	Whiting	2.52
Iowa	17.8	−1.9	Keokuk WBO	63	15	Independence	−26	30	2.68	+1.66	Winterset	5.20	Alton	.85
Kansas	27.7	−2.3	Columbus	69	3	Sedan	−27	30	4.15	+3.41	Coffeyville	7.57	2 stations	.34
Kentucky	43.3	+7.6	Pikeville	77	16	Covington WBAS	+5	30	6.57	+2.23	Lovelaceville	11.15	Jenkins Water Works	3.42
Louisiana	54.9	+3.5	Amite	89	9	Grand Cane	1	31	6.08	+1.08	Jonesville	11.94	Schriever	1.20
Maryland-Delaware	41.4	+9.2	La Plata, Md	74	28	Sines (Deep Creek), Md.	1	30	5.30	+2.02	Oakland, Md	7.35	Crisfield, Md	1.94
Michigan	26.0	+5.1	Benton Harbor Ap	60	[1]15	Dunbar Forest Experiment Station.	−20	29	2.75	+.80	Pontiac State Hospital.	5.33	Watton	.80
Minnesota	10.1	+.4	St. Peter, 2 SW	49	7	Warroad	−47	20	1.64	+.91	Pine River Dam Cross Lake.	4.82	Oaklee	.62
Missouri	30.2	−.6	Caruthersville	73	15	Bethany	−24	30	6.07	+3.70	Sikeston	12.62	Memphis	3.35
Montana	5.0	−14.6	Rapelje	60	7	Polebridge	−44	20	.84	−.08	Hebgen Dam	3.03	Scobey	T
Nebraska	13.0	−10.4	Falls City	55	7	Valentine Lakes Game Refuge.	−29	21	2.02	+1.47	Falls City	4.78	Indianola, 2 N	.21
Nevada	15.0	−15.0	Las Vegas	57	6	2 stations	−38	25	1.10	+.10	Las Vegas	3.71	Lahontan	.06
New England	28.4	+5.6	Sandwich, Mass	61	19	Houlton, Maine	−23	26	4.10	+.63	Norfolk, Conn	8.32	Bethlehem, N. H	1.61
New Jersey	38.0	+7.2	Long Branch	68	19	3 stations	8	[1]4	5.99	+2.36	Paterson	7.55	Canton	4.47
New Mexico	27.8	−5.5	Carlsbad	69	24	Gavilan	−40	5	1.64	+1.03	White Signal	4.41	Newcomb	.19
New York	28.6	+5.6	Middleburg	64	20	Gouverneur	−21	15	3.49	+.62	Cutchogue	8.17	Plattsburg	1.25
North Dakota	2.5	−4.6	Elbowoods	58	7	Medora	−46	21	1.08	+.61	Grano	3.68	Grenora	.03
Ohio	36.3	+7.9	2 stations	71	[1]16	2 stations	−2	30	5.49	+2.53	Oxford	10.61	Put-in-Bay Stone Lab.	2.53
Oklahoma	31.4	−6.6	3 stations	77	[1]3	do	−21	30	5.41	+3.92	Cloudy Town	12.84	Kenton, near	.47
Oregon	18.7	−12.9	Brookings	62	28	Danner	−36	25	1.09	−2.61	Summit Guard Station.	5.28	Warm Springs Agency.	T
Pennsylvania	35.3	+7.0	4 stations	66	[1]9	2 stations	−4	30	4.83	+1.67	Kregar, 4 SE	7.70	Tunkhannock	1.89
South Dakota	8.3	−8.7	Longvalley	63	7	Ralph	−42	21	1.42	+.86	Lead	4.78	Gelhaus Farm	.35
Texas	41.2	−7.0	Bishop	90	4	Lampasas	−12	31	3.62	+1.81	Honey Grove	11.38	Brownsville WBAS	.39
Utah	13.7	−12.9	Mexican Hat	57	12	Woodruff	−47	29	2.11	+.97	Alta	10.31	Koosharem	.44
Virginia	44.2	+7.7	2 stations	76	[1]10	Big Meadows	3	30	3.82	+.61	Rose Hill	7.58	Langley Air Force Base.	1.10
Washington	17.8	−13.0	do	55	[1]5	Cheney	−35	2	.99	−3.38	Snoqualmie Pass	4.96	Othello	.06
West Virginia	42.0	+9.3	Williamson	77	17	2 stations	0	30	4.87	+1.29	Pickens No. 2	11.44	Salem	2.54
Wisconsin	18.7	+3.4	Beloit College	57	8	Hatfield Power Co. Dam.	−34	30	1.92	+.69	Superior Power Plant	3.77	Ridgeland	.86
Wyoming	7.3	−12.5	Metz Ranch	64	7	Bondurant	−50	25	1.39	+.60	Alva	4.30	Basin	.17
Hawaii	67.5	−1.1	Mahukona	88	[1]3	Haleakiala R. S.	32	31	15.21	+7.82	Makahanaloa No. 2	49.60	Ahua Umi	1.95
Puerto Rico	72.1	−.9	Ponce	95	24	Utuado	48	3	2.56	−.67	Rio Blanco (1,800 feet elevation.	9.72	Vieques Island	T

[1] Other dates also.

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR JANUARY 1949

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Date	Lowest	Date	Greatest daily range	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
NEW ENGLAND									28.8	+7.0								74	4.15	+0.5														7.4	
Caribou [3]	628	5	33	997.0	1,020.8	------	23	3	13.0	+6.1	45	6	−21	26	----	1,609	8	77	2.50	+.1	.77	14	0	20.0	12.0	12.5	nw.	--	------	--	5	6	20	7.5	..
Eastport	75	67	82	1,018.0	1,021.0	+5.8	34	19	26.2	+5.8	50	6	0	21	----	1,201	19	70	4.56	+.6	1.72	13	0	20.4	4.0	11.3	n.	34	s.	6	5	5	21	7.9	41
Portland, Me. [3]	103	6	43	1,018.6	1,020.7	+3.4	35	18	26.6	+6.5	53	6	−1	15	----	1,188	20	75	4.65	+.7	1.82	15	0	21.3	10.0	8.2	n.	27	se.	6	6	7	18	7.1	42
Concord [3]	289	5	45	1,008.1	1,021.1	+3.8	36	19	27.7	+8.7	55	6	3	31	----	1,159	20	73	4.24	+1.2	1.65	14	0	20.1	13.0	6.8	n.	29	w.	29	5	7	19	6.8	28
Mt. Washington	6,274	5	37	801.2	1,022.0	------	20	4	12.0	+6.0	37	16	−25	30	----	1,645	8	77	4.82	−1.1	1.30	16	0	20.1	9.0	45.9	w.	--	------	--	4	5	22	8.0	21
Burlington [3]	403	6	51	1,007.8	1,020.9	+3.3	33	17	25.0	+6.2	53	19	−6	15	----	1,237	19	76	2.09	+.3	.43	19	0	17.5	5.0	10.4	s.	37	s.	16	3	7	21	7.7	27
Boston [3]	124	33	62	1,020.7	1,021.4	+4.1	42	28	34.6	+6.7	60	19	14	15	----	940	24	68	3.21	−.4	.81	9	0	13.7	2.0	11.9	w.	48	nw.	6	8	5	18	7.0	38
Nantucket [3]	12	4	34	1,020.7	1,019.7	+2.8	43	31	36.6	+5.3	52	28	19	30	----	877	31	79	3.70	−.1	.60	13	0	6.6	.0	15.3	n.	45	se.	31	4	5	22	7.9	24
Block Island	26	11	46	1,019.3	1,020.8	+3.5	43	32	37.6	+6.6	55	19	18	30	----	844	33	82	4.93	+1.2	1.46	14	0	4.2	.0	18.2	nw.	54	se.	31	7	7	17	6.9	39
Providence [3]	159	65	60	1,018.6	1,021.2	+3.2	44	29	36.3	+9.1	60	19	15	30	----	889	26	70	4.23	+.5	1.18	10	0	10.3	4.0	9.3	n.	34	sw.	6	6	8	17	7.0	39
Hartford [3]	159	5	44	1,021.3	1,021.5	+2.9	42	26	34.0	+8.5	57	8	10	30	----	963	26	74	4.99	+1.0	1.78	12	0	16.4	7.0	8.6	n.	30	s.	6	2	11	18	7.5	35
New Haven [3]	107	5	39	1,021.0	1,021.3	+2.7	42	29	35.7	+8.3	59	8	16	30	----	911	28	71	5.87	+2.2	1.61	12	0	14.0	4.0	7.6	n.	24	e.	31	3	10	18	7.3	45
MIDDLE ATLANTIC									40.0	+8.3								74	4.55	+1.3														7.5	
Albany [3]	97	6	40	1,011.9	1,021.1	+2.1	37	21	28.8	+8.7	56	19	−2	30	----	1,119	22	76	2.78	+.4	.68	6	0	20.6	8.0	11.1	n.	42	w.	19	2	6	23	8.4	37
Binghamton [4]	871	57	79	990.9	1,021.2	+2.6	40	25	32.4	+8.3	58	19	10	4	----	1,013	24	74	2.79	+.3	.62	19	0	11.0	2.0	6.8	w.	24	w.	29	2	5	24	8.4	38
New York [4]	314	415	454	1,020.7	1,022.2	+3.2	46	32	39.0	+8.1	61	19	18	30	----	807	28	66	5.63	+2.0	1.71	13	0	4.8	2.0	14.8	w.	45	w.	6	3	11	17	7.1	44
Allentown [3]	385	4	58	1,007.8	1,022.2	------	43	27	35.0	+5.7	60	19	14	30	----	928	27	75	6.01	+2.5	2.47	13	0	7.4	4.0	8.5	e.	40	w.	1	4	8	19	7.6	..
Harrisburg [3]	374	30	49	1,008.8	1,021.9	+1.6	43	30	36.8	+7.8	56	7	15	30	----	873	28	73	4.18	+1.1	1.31	15	0	6.9	6.0	7.5	w.	39	nw.	1	5	3	23	7.9	30
Philadelphia [4]	114	174	150	1,015.9	1,021.9	+1.9	47	34	40.5	+7.9	63	19	20	30	----	760	32	74	6.33	+3.0	1.43	15	0	4.1	3.0	7.5	w.	22	nw.	6	6	4	21	7.2	42
Reading	323	47	306	1,009.1	1,021.0	+.7	45	32	38.6	+7.5	60	19	17	30	----	817	----	--	6.36	+2.8	2.26	13	0	7.2	6.0	11.2	w.	44	se.	27	5	6	20	7.5	38
Scranton	805	72	104	991.5	1,021.3	+1.7	41	38	34.0	+7.4	58	19	13	30	----	960	----	--	3.22	+.2	1.35	14	0	5.9	4.0	6.9	n.	26	se.	19	4	10	17	7.7	25
Atlantic City	52	37	172	1,020.0	1,021.6	+2.0	48	36	41.7	+9.2	60	17	24	30	----	726	35	75	6.28	+2.8	1.47	13	0	T	.0	16.1	n.	49	s.	6	5	6	20	7.4	44
Newark [3]	30	5	46	1,020.3	1,021.6	------	45	30	37.6	+7.8	62	19	18	30	----	852	29	70	6.33	+2.5	1.81	14	0	6.1	2.0	----	----	33	nw.	1	6	8	17	7.0	..
Trenton	190	89	107	1,014.9	1,022.0	+2.4	46	32	39.3	+8.8	62	19	18	30	----	796	----	--	5.40	+2.1	1.50	13	0	4.5	3.0	9.0	sw.	30	nw.	2	5	7	19	7.3	34
Baltimore [4]	123	100	215	1,017.6	1,022.5	+2.2	49	36	42.3	+8.5	70	28	20	30	----	702	31	71	6.13	+2.6	1.89	15	0	4.2	1.0	9.9	n.	56	nw.	6	5	7	19	7.2	34
Washington [4]	112	56	100	1,020.3	1,022.4	+2.1	51	36	43.4	+10.0	73	28	19	30	----	674	----	76	5.08	+1.5	1.55	16	0	5.0	2.0	7.5	e.	30	w.	1	6	6	19	7.4	33
Cape Henry	18	8	54	1,021.3	1,022.7	+2.7	56	42	48.7	+8.5	74	17	31	30	----	505	42	82	1.48	−1.7	.73	9	0	T	.0	11.6	sw.	35	n.	20	7	4	20	7.2	42
Lynchburg [3]	686	5	58	987.8	1,022.5	+1.8	54	36	45.0	+9.7	72	28	20	31	----	619	35	75	4.45	+1.0	1.75	18	0	4.1	3.0	7.2	sw.	35	sw.	28	5	6	20	7.3	36
Norfolk [4]	91	80	125	1,022.0	1,022.7	+2.0	57	42	49.8	+9.2	74	17	31	30	----	472	39	74	1.62	−1.5	.73	10	0	.4	.0	9.7	ne.	34	w.	1	6	3	22	7.5	44
Richmond [4]	144	11	52	1,015.6	1,022.1	+1.4	55	38	46.4	+8.5	72	28	23	30	----	577	36	74	3.25	.0	1.25	16	0	1.3	.0	7.6	ne.	31	sw.	28	8	4	19	7.1	35
SOUTH ATLANTIC									54.3	+9.5								76	1.98	−1.6														6.8	
Asheville	2,253	77	92	------	1,023.1	+1.4	56	39	47.4	+12.0	74	24	21	30	----	543	39	--	2.06	−1.0	1.00	10	0	3.2	T	9.1	nw.	29	s.	18	6	3	22	7.6	47
Charlotte [4]	779	63	86	994.6	1,022.8	+1.8	60	44	51.6	+10.4	77	10	27	31	----	414	41	73	3.94	−.1	1.73	8	0	.6	T	7.0	sw.	25	s.	28	4	4	23	7.7	48
Greensboro [3]	886	6	56	990.5	1,023.1	+2.4	57	38	47.7	+9.8	74	25	22	2	----	536	39	75	2.75	−.8	1.13	4	0	1.2	T	8.7	sw.	24	sw.	28	5	4	22	7.2	42
Hatteras	11	5	47	1,022.0	10,22.7	+2.7	58	47	52.2	+5.1	67	17	37	30	----	395	48	86	2.36	−2.1	1.10	8	0	T	0	11.7	ne.	40	w.	1	5	6	20	6.6	56
Raleigh [4]	376	5	71	1,006.8	1,022.9	+1.9	59	42	50.3	+9.2	79	25	27	30	----	460	41	77	2.66	−1.0	.85	10	0	T	0	7.2	w.	23	sw.	28	7	8	16	6.8	35
Wilmington	72	73	107	1,022.0	1,023.1	+1.8	66	47	56.7	+10.2	77	27	31	1	----	266	47	--	1.56	−1.7	.70	8	0	T	0	8.8	sw.	29	sw.	28	7	9	15	6.3	57
Charleston [4]	48	11	92	1,021.0	1,022.9	+1.9	67	51	58.9	+9.0	81	25	31	1	----	207	48	76	.66	−2.4	.21	8	0	.0	0	9.1	w.	26	ne.	30	10	8	13	6.0	60
Columbia, S. C. [4]	347	70	91	1,014.6	1,022.9	+1.6	66	47	56.1	+10.1	82	10	31	1	----	280	45	75	.69	−2.7	.27	7	0	T	0	8.0	sw.	24	sw.	26	7	3	21	7.2	36
Greenville, S. C. [3]	1,040	18	36	984.8	1,022.4	+2.1	59	43	50.8	+10.5	79	11	24	1	----	444	42	74	4.23	−.6	1.93	11	0	1.5	T	8.4	sw.	32	ne.	4	5	6	20	7.2	44
Augusta [4]	182	62	77	1,006.8	1,023.0	+2.0	67	47	57.0	+10.0	83	11	30	1	----	260	44	69	.98	−3.0	.46	6	0	.0	0	5.5	nw.	24	nw.	12	6	7	18	7.1	54
Savannah [3]	65	19	51	1,021.3	1,023.3	+.9	70	50	59.9	+10.1	83	11	29	1	----	199	50	76	.48	−2.3	.23	7	0	.0	0	9.2	sse.	32	w.	12	6	7	18	6.7	50
Jacksonville [4]	43	86	110	1,021.7	1,023.3	+2.0	73	54	63.4	+8.0	82	12	32	1	----	113	55	81	1.46	−1.3	.81	4	0	.0	0	7.3	s.	24	sw.	28	13	7	11	5.0	58
FLORIDA PENNINSULA									70.6	+4.6								74	.24	−2.1														3.7	
Key West [4]	21	10	64	1,020.3	1,021.2	+1.9	78	69	73.5	+4.0	82	29	56	2	----	8	64	76	.39	−1.6	.17	7	0	.0	.0	9.8	e.	23	e.	23	19	11	1	3.4	73
Miami [4]	25	242	249	1,021.3	1,021.7	+1.7	76	66	71.0	+3.1	80	13	41	1	----	26	60	71	.14	−2.1	.08	3	0	.0	.0	15.4	se.	34	e.	21	15	15	1	3.6	85
Tampa [3]	35	5	36	1,021.7	1,022.5	+1.8	78	57	67.2	+6.8	82	19	38	1	----	48	57	74	.18	−2.5	.14	2	0	.0	.0	6.5	e.	21	s.	28	14	8	9	4.0	68
EAST GULF									56.6	+7.9								78	4.69	+.1														7.1	
Atlanta [3]	1,173	33	72	987.5	1,022.9	+1.6	60	43	51.8	+9.3	79	11	27	1	----	414	43	75	4.57	−.5	1.60	13	0	T	.0	11.2	nw.	31	se.	18	3	10	18	7.3	36
Macon [4]	370	79	87	1,007.1	1,022.9	+1.6	66	46	56.0	+9.2	82	11	30	1	----	288	46	72	1.76	−2.4	.77	7	0	T	.0	6.1	nw.	22	s.	18	5	7	19	7.3	45
Thomasville	273	48																																	
Apalachicola	35	11	51	1,021.0	1,022.4	+1.4	68	54	61.0	+7.3	79	12	32	1	----	146	----	--	2.10	−1.6	.71	8	0	.0	.0	8.1	se.	23	se.	30	12	4	15	5.2	63
Penascola [4]	56	54	79	1,020.0	------	------	66	52	59.2	+6.7	79	11	31	1	----	207	----	--	2.12	−1.9	1.05	11	1	.0	.0	8.1	se.	23	se.	3	7	5	19	6.9	48
Anniston	618	6	32	1,000.0	1,022.8	+1.5	63	42	52.6	------	80	10	18	1	----	387	45	80	5.89	+.8	2.10	11	0	T	.0	7.6	ene.	32	se.	27	2	12	17	7.4	..
Birmingham [3]	700	5	63	999.3	1,022.6	+.6	62	43	52.5	+9.6	81	10	20	1	----	393	45	79	11.00	+5.5	5.81	11	2	1.0	T	8.8	sse.	38	w.	18	3	8	20	7.6	25
Mobile [4]	57	86	161	1,013.9	1,022.2	+.9	67	52	59.4	+7.9	83	11	31	31	----	210	52	82	2.52	−2.3	.93	11	0	T	.0	12.7	se.	37	se.	18	6	7	18	6.8	42
Montgomery [4]	218	92	105	1,014.9	1,022.5	+.5	66	48	57.0	+8.5	83	11	29	1	----	274	48	78	4.12	−1.1	1.90	11	0	T	.0	7.6	se.	22	s.	18	6	7	18	6.8	44
Meridian [4]	375	67	92	1,010.8	1,022.2	+.9	66	45	55.5	+8.5	83	10	22	1	----	317	48	80	5.39	+.1	1.33	11	1	.6	T	7.5	sse.	----	----	--	2	9	20	7.7	..
Vicksburg [4]	247	82	102	1,011.9	1,021.6	−.1	62	44	53.0	+4.8	81	10	19	30	----	389	45	--	10.78	+5.4	2.87	12	3	5.5	3.0	9.3	s.	30	s.	27	1	8	22	8.2	29
New Orleans C. O.	53	76	84	1,019.3	------	------	69	53	60.9	+6.7	82	22	30	31	----	191	----	--	3.26	−1.1	1.36	10	0	T	0	6.8	se.	----	----	18	8	7	16	6.3	37
New Orleans A. P. [3]	30	6	52	1,019.3	1,021.4	------	68	51	59.8	------	81	22	29	31	----	212	53	80	2.78	------	------	10	0	T	0	7.9	sse.	----	----	--	7	6	18	7.2	..

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR JANUARY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level[1]	Elevation: Thermometer above ground	Elevation: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Date	Lowest	Date	Greatest daily range	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity[6]	Precipitation: Total	Departure from normal	Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Prevailing direction	Speed fastest mile: Miles per hour	Direction	Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover[7] tenths (sunrise to sunset)	Possible sunshine
WEST GULF	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
									48.2	−1.9								79	5.25	+2.6														8.4	
Shreveport[3]	181	5	64	1,014.6	1,021.5	+.2	57	40	48.2	+.6	80	9	8	31	----	536	42	82	7.81	+3.9	2.22	13	4	7.7	3.0	9.9	sse.	30	nw.	16	0	5	26	8.8	28
Fort Smith[3]	463	6	30	1,004.4	1,021.3	+.3	47	30	38.3	−1.2	72	8	8	31	----	827	31	78	11.33	+8.8	5.42	17	2	.8	T	8.6	w.	30	nw.	3	2	2	27	8.7	27
Little Rock[3]	265	26	58	1,011.5	1,021.9	−1.1	51	36	43.6	+2.2	75	9	10	31	----	671	38	80	11.91	+7.2	3.24	15	3	3.0	T	8.9	ne.	38	sw.	27	2	3	26	8.6	19
Austin[3]	621	5	41	998.3	1,021.4	+.7	55	36	45.1	−4.4	82	3	−2	31	----	628	38	80	3.97	+1.9	.84	18	3	6.5	4.0	10.6	s.	34	n.	29	3	2	26	8.4	33
Brownsville[3]	20	5	54	1,017.3	1,018.5	−.1	67	51	59.0	−.8	82	9	23	31	----	261	51	79	.39	−1.4	.18	8	0	.0	.0	12.7	nnw.	34	s.	15	1	4	26	8.5	19
Corpus Christi[3]	44	6	33	1,018.0	1,020.2	+.2	63	46	54.4	+.4	86	3	20	31	----	375	46	77	1.03	−.5	.61	14	0	T	.0	12.7	nnw.	41	se.	9	2	6	23	8.5	30
Dallas[3]	488	34	45	1,002.7	1,022.1	+1.1	49	31	39.9	−5.5	79	9	2	31	----	780	32	76	8.46	+6.1	5.14	16	1	3.3	2.0	9.0	nnw.	31	n.	29	4	3	24	8.1	21
Fort Worth[3]	706	40	56	995.9	1,022.2	+1.5	49	30	39.1	−5.3	78	9	−2	31	----	806	30	75	5.45	+3.4	1.36	15	3	3.5	1.0	14.6	nnw.	--	----	--	6	5	20	7.7	--
Galveston[4]	54	122	129	1,020.0	1,020.7	.0	59	48	54.0	+.2	72	25	24	30	----	352	49	85	3.27	−.1	.81	11	2	.8	.0	13.0	n.	34	w.	27	3	5	23	8.0	28
Houston[4]	138	157	190	1,018.0	1,021.0	+.3	60	44	52.5	−.2	79	3	14	31	----	420	46	81	4.59	+.9	2.05	13	2	2.6	1.0	11.4	n.	31	s.	15	1	5	25	8.8	20
Laredo[3]	418	10	38	1,000.3	1,019.5	----	63	44	53.2	−5.7	90	3	22	31	----	398	42	70	.92	−.2	.51	10	0	T	.0	9.1	se.	--	----	--	1	5	25	8.6	--
Palestine	510	64	72	1,003.1	1,021.6	+.6	54	37	45.5	−2.7	80	3	13	31	----	612	38	76	6.10	+2.7	1.78	16	2	5.2	3.0	8.2	s.	21	sw.	27	2	3	26	8.7	27
Port Arthur[4]	34	59	134	1,019.3	1,020.5	−.2	62	48	55.0	+1.2	76	11	19	31	----	327	49	85	5.39	+1.7	1.89	14	4	1.7	T	13.7	n.	35	s.	2	1	9	21	8.1	34
San Antonio[3]	794	6	51	991.2	1,020.8	+.8	56	37	46.5	−5.8	81	9	0	31	----	580	38	76	2.91	+1.4	.77	15	1	4.7	3.0	10.1	ne.	36	n.	16	3	2	26	8.4	28
OHIO VALLEY AND TENNESSEE																																			
									40.9	+8.3								80	7.29	+3.5														8.5	
Chattanooga[3]	762	6	66	997.3	1,022.9	+1.2	58	41	49.6	+10.5	78	11	18	1	----	477	42	78	11.00	+5.7	4.44	13	0	3.0	T	5.3	s.	34	nw.	28	3	5	23	8.0	23
Knoxville[3]	995	27	71	986.8	1,022.8	+1.5	57	40	48.4	+10.7	76	10	20	1	----	513	41	79	6.81	+2.2	2.51	15	0	2.0	.0	8.8	sw.	43	sw.	19	4	5	22	7.7	33
Memphis[5]	399	5	49	----	1,021.9	+.2	53	38	45.2	+5.5	72	10	16	30	----	616	39	81	8.87	+4.1	2.75	17	4	4.0	3.0	9.3	n.	38	sw.	18	2	5	24	8.6	24
Nashville[7]	546	5	72	999.7	1,022.2	+.2	54	39	46.6	+8.0	75	10	14	30	----	571	41	82	7.12	+2.4	1.57	15	2	3.5	2.6	9.1	sse.	56	sw.	27	2	1	28	8.0	17
Lexington[3]	989	4	58	985.1	1,022.6	+2.3	49	33	41.2	+8.3	69	16	10	30	----	735	36	83	5.55	+1.4	1.20	20	1	2.6	2.0	14.7	s.	--	----	--	3	1	27	8.8	--
Louisville[3]	525	5	54	1,003.7	1,021.9	+.6	45	34	41.0	+8.2	71	18	9	30	----	726	35	79	7.10	+3.1	1.36	15	2	2.7	2.0	9.3	s.	48	sw.	19	3	1	27	8.8	20
Evansville[3]	431	6	40	1,007.5	1,022.0	+.3	47	31	39.0	+7.4	70	15	7	30	----	807	33	82	8.84	+5.1	2.11	14	4	2.7	2.0	10.1	w.	43	sw.	27	2	3	26	8.7	19
Indianapolis[3]	823	5	54	991.2	1,021.6	+1.3	42	26	34.0	+6.7	60	15	0	30	----	958	29	83	7.41	+4.5	1.96	16	2	1.2	1.0	12.4	w.	80	sw.	19	1	7	23	8.3	20
Terre Haute[3]	575	4	36	999.3	1,022.0	+1.3	42	27	34.2	+5.5	62	15	0	30	----	956	28	80	8.22	+5.5	3.13	16	2	2.1	T	11.8	nw.	47	sw	27	3	5	23	8.4	25
Cincinnati[4]	627	135	148	989.5	1,022.1	+1.1	48	33	40.7	+8.4	69	9	8	30	----	756	33	82	9.60	+6.1	2.60	17	1	2.8	2.0	5.2	se.	17	sw.	18	1	4	26	8.8	15
Columbus[4]	822	90	110	990.9	1,021.7	+1.4	44	31	37.4	+8.8	63	18	6	30	----	855	31	81	6.74	+3.7	1.88	16	1	4.5	2.0	9.4	s.	52	sw.	19	2	4	25	8.6	16
Dayton[3]	1,003	6	55	984.4	1,021.7	+1.7	43	28	35.4	+7.7	63	18	3	30	----	919	30	82	7.23	+4.0	2.54	16	1	5.0	2.0	12.6	w.	49	sw.	18	1	5	25	8.8	19
Elkins[3]	1,947	5	45	948.9	1,022.1	+.8	50	31	40.5	+10.5	66	16	6	30	----	758	34	80	6.09	+2.3	.97	18	0	3.4	.0	7.3	w.	39	nw.	1	3	5	23	8.3	31
Parkersburg	637	77	84	989.8	----	----	49	33	41.2	+8.7	67	18	9	30	----	735	32	80	4.76	+1.2	1.00	18	0	4.8	3.0	7.3	sw.	21	se.	18	3	3	25	8.5	17
Pittsburgh[3]	842	39	54	973.9	1,021.0	+1.0	45	31	38.4	+9.8	63	9	5	30	----	840	30	75	3.95	+.9	.92	18	0	4.9	2.0	11.4	nw.	48	nw.	1	1	5	25	8.8	19
LOWER LAKES																																			
									31.3	+7.5								79	3.33	+.7														8.4	
Buffalo[3]	768	34	96	993.2	1,020.2	+2.2	38	24	31.2	+7.3	58	19	8	30	----	1,045	25	78	2.71	−.6	.49	17	0	11.9	3.0	15.9	sw.	59	sw.	19	1	3	27	9.1	17
Canton	448	10	61	1,003.7	1,020.3	+2.7	32	14	23.2	+6.6	57	19	−15	15	----	1,295	17	78	2.55	.0	.45	18	0	27.5	3.0	8.7	w.	42	w.	19	2	7	22	8.3	29
Oswego	335	71	85	----	----	----	36	22	29.2	+5.6	57	19	8	15	----	1,109	----	--	2.90	.0	.54	16	0	22.6	----	11.4	se.	28	se.	18	0	6	25	9.1	13
Rochester[3]	523	4	69	1,005.1	1,020.5	+1.9	37	24	30.2	+7.2	58	9	8	30	----	1,077	24	78	2.36	−.5	.61	16	0	14.0	6.0	12.8	w.	52	sw.	19	2	2	27	8.7	23
Syracuse[3]	596	5	57	1,006.1	1,021.2	+2.6	38	21	29.4	+6.6	58	19	4	15	----	1,096	23	75	3.25	+.5	.61	20	0	22.2	8.0	9.1	e.	51	s.	19	1	3	27	8.6	28
Erie[4]	714	57	81	993.2	1,020.8	+2.2	41	29	35.0	+8.2	60	19	9	30	----	929	27	--	3.55	+.8	.75	20	1	6.4	1.0	10.6	w.	33	se.	19	3	6	22	8.4	19
Cleveland[3]	762	27	54	992.6	1,021.0	+3.0	42	27	34.8	+10.1	64	19	0	30	----	934	29	81	3.61	+1.1	.54	17	0	7.1	5.0	14.0	w.	48	sw.	19	4	4	23	8.5	23
Sandusky	629	5	67	997.3	----	----	42	28	35.1	+8.8	63	18	4	30	----	929	----	--	3.09	+.8	.76	16	0	3.6	3.0	11.0	sw.	37	sw.	19	4	7	20	8.0	27
Toledo[3]	628	5	47	997.0	1,020.8	+1.2	40	26	32.8	+8.3	59	18	3	30	----	999	27	80	3.37	+1.2	.87	16	0	3.2	2.0	13.9	w.	66	sw.	19	4	4	23	8.2	27
Fort Wayne[3]	857	5	34	989.8	1,021.1	+1.5	39	25	31.8	+6.4	57	15	0	30	----	1,028	26	87	6.49	+4.2	2.40	15	0	4.9	2.0	9.1	sw.	59	sw.	18	1	9	21	8.2	28
Detroit[3]	730	5	77	997.0	1,020.9	+1.9	38	25	31.6	+7.5	56	19	4	30	----	1,035	24	75	2.74	+.7	.89	13	0	4.6	3.0	12.1	e.	57	sw.	19	7	3	21	7.7	31
UPPER LAKES																																			
									23.6	+6.2								78	2.46	+.6														7.7	
Alpena	609	5	89	996.3	----	----	33	20	26.4	+7.3	49	16	0	29	----	1,196	----	--	1.90	.0	.85	14	0	11.4	6.0	12.0	sw.	47	sw.	19	2	4	25	8.5	22
Escanaba	612	51	72	996.3	----	----	29	14	21.8	+6.5	47	7	−9	30	----	1,337	----	--	1.95	+.5	.43	15	0	16.6	15.0	11.2	n.	37	n.	28	3	9	19	7.4	38
Grand Rapids[4]	707	70	244	994.2	1,020.2	+1.6	36	24	30.2	+5.7	58	16	4	30	----	1,075	23	81	2.69	+.3	1.22	16	0	5.4	3.0	12.7	sw.	61	sw.	19	2	6	23	8.4	21
Lansing[4]	878	5	90	987.5	1,020.3	+2.0	36	21	[illegible]	+6.2	55	16	−2	30	----	1,142	23	81	3.48	+1.7	1.50	16	0	6.4	2.0	12.7	w.	49	sw.	19	6	5	20	7.6	29
Marquette	734	44	73	990.9	----	----	29	16	22.4	+6.1	48	7	−3	29	----	1,322	----	--	2.11	−.2	.68	17	0	20.8	18.0	8.6	w.	26	sw.	30	1	4	26	8.7	19
Sault Sainte Marie[3]	614	10	52	991.9	1,018.3	+.7	26	10	18.3	+6.2	43	16	−15	29	----	1,447	0	78	3.13	+1.1	.81	19	0	38.6	24.0	11.9	e.	41	nw.	19	3	7	21	7.9	40
Chicago[3]	673	5	38	997.3	1,020.8	+1.2	36	21	28.4	+6.1	60	15	−4	30	----	1,134	22	78	3.32	+1.4	1.12	14	0	.5	T	10.5	e.	36	w.	6	7	5	19	7.1	35
Green Bay	617	5	32	996.6	----	----	29	12	20.8	+5.1	45	15	−13	20	----	1,365	----	--	1.85	+.3	.51	15	0	11.9	8.0	8.9	n.	26	se.	21	6	6	19	7.5	40
Milwaukee[3]	681	33	66	993.9	1,020.4	+1.8	33	18	25.6	+6.2	54	15	−10	30	----	1,225	19	76	2.59	+.8	.92	12	0	13.7	8.0	14.7	w.	42	w.	6	7	6	18	6.8	35
Duluth[4]	1,133	5	47	965.8	1,020.1	+1.8	22	6	14.0	+6.1	42	7	−22	29	----	1,579	6	77	1.62	+.6	.61	11	0	14.5	10.0	13.3	w.	49	nw.	28	4	12	15	6.9	40
NORTH DAKOTA																																			
									1.9	−2.7								75	.88															6.8	
Fargo[3]	940	5	47	987.5	1,022.8	+2.1	13	−6	3.6	−.2	40	7	−25	21	----	1,907	−2	76	1.24	+.6	.68	12	0	12.4	11.0	15.4	n.	42	n.	8	3	7	21	7.7	39
Bismarck[3]	1,677	5	41	960.0	1,024.4	+3.7	13	−8	2.5	−3.8	46	7	−33	21	----	1,934	−4	74	.74	+.3	.30	11	0	11.8	9.0	13.7	n.	50	n.	4	6	7	18	7.2	52
Devils Lake	1,478	11	44	965.1	----	----	10	−8	.5	−1.3	39	7	−31	21	----	1,999	----	--	.98	+.5	.28	12	0	12.9	20.0	10.6	n.	34	ne.	8	8	7	16	5.0	49
Grand Forks[3]	832	4	41	----	----	----	----	----	----	----	----	----	----	----	----	----	----	--	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	--
Williston	1,878	42	50	953.3	----	----	11	−9	1.0	−5.4	46	7	−31	21	----	1,982	----	--	.57	.0	.43	9	0	5.7	9.0	7.7	nw.	27	nw.	15	4	7	20	7.5	51

See footnotes at end of table

CLIMATOLOGICAL DATA FOR WEATHER BUREAU STATIONS FOR JANUARY 1949—Continued

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air: Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Extremes: Date	Extremes: Lowest	Extremes: Date	Greatest daily range	Total heating degree days	Mean temperature of the dew-point	Mean relative humidity [6]	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Speed fastest mile: Miles per hour	Speed fastest mile: Direction	Speed fastest mile: Date	Character of day (sunrise to sunset), number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
UPPER MISSISSIPPI	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
Minneapolis-									23.9	+2.8								78	4.25	+2.6														7.1	
St. Paul [2]	919	43	74	988.8	1,021.2	+1.9	21	4	14.0	+1.3	45	7	−18	22	----	1,579	6	70	1.65	+.8	.79	11	0	12.5	10.0	11.7	w.	33	sw.	30	7	7	17	6.8	40
La Crosse [2]	672	5	29	995.3	1,021.2	+1.6	27	8	17.4	+3.1	47	7	−20	29	----	1,473	11	77	2.03	+1.0	.44	12	0	14.1	10.0	9.8	nw.	37	nw.	19	6	8	17	6.6	45
Madison [2]	974	27	39	988.2	1,021.0	+1.4	30	12	20.8	+4.1	51	15	−19	20	----	1,370	15	76	1.97	+.6	.53	11	0	12.7	7.0	13.6	w.	42	w.	5	9	5	17	6.6	38
Charles City	1,015	10	51	983.7	1,022.7	+2.4	25	9	16.8	+3.1	46	7	−14	30	----	1,491	----	--	2.91	+1.9	.94	12	0	11.7	8.0	7.7	nw.	21	sw.	5	11	5	15	6.0	44
Moline [2]	606	6	50	999.0	1,022.2	+1.5	31	15	23.0	+2.8	56	15	−15	20	----	1,302	17	76	3.28	+1.9	1.06	11	0	5.3	2.0	11.5	w.	38	w.	5	7	6	18	6.9	36
Des Moines [4]	860	5	99	985.4	1,022.5	+2.2	27	12	19.2	−.9	53	7	−11	30	----	1,423	13	78	3.03	+2.0	1.13	11	0	18.3	10.5	11.3	nw.	33	n.	27	8	6	17	6.6	40
Dubuque	609	60	79	994.6	1,021.7	+1.7	31	13	22.0	+2.9	52	15	−16	30	----	1,336	16	74	2.93	+1.6	1.38	13	0	17.7	9.0	6.0	nw.	20	n.	28	8	7	16	6.6	45
Burlington [2]	702	4	36	994.9	1,022.0	+1.3	32	16	23.7	+1.6	55	15	−7	30	----	1,277	20	84	2.46	+.8	.52	14	0	6.7	2.0	12.5	nw.	40	sw.	5	7	5	19	7.2	37
Cairo	357	5	99	1,008.8	------	------	48	34	41.0	+6.1	70	15	9	30	----	742	----	--	13.16	+9.4	6.09	16	3	1.9	1.0	10.5	ne.	40	sw.	27	3	2	26	8.6	28
Peoria [2]	609	7	26	998.6	1,022.0	+1.3	34	19	26.5	+2.4	63	15	−4	30	----	1,191	21	79	4.43	+2.6	1.01	15	0	3.2	1.0	13.1	w.	52	w.	27	5	4	22	7.8	34
Springfield, Ill. [4]	636	5	191	998.6	1,020.6	+.3	36	22	29.2	+4.5	65	15	−2	30	----	1,105	24	81	5.67	+3.6	1.50	14	0	1.3	T	13.3	nw.	65	sw.	27	6	4	21	7.7	38
St. Louis [4]	568	33	59	1,001.4	1,022.0	+1.3	40	26	33.2	+2.1	66	15	2	30	----	966	27	82	7.46	+5.1	2.17	15	1	1.9	.5	11.4	s.	39	s.	15	2	6	23	8.2	26
MISSOURI VALLEY																																			
									19.0	−4.2								78	3.67	+2.6														7.0	
Columbia, Mo. [4]	784	6	66	992.6	1,020.7	.0	37	22	29.8	−1.1	66	15	−3	30	----	1,092	23	84	6.29	+4.4	1.61	13	0	2.7	1.0	8.0	nw.	25	w.	5	4	6	21	7.9	25
Kansas City [2]	963	38	76	993.6	1,022.5	+1.5	33	18	26.0	−2.2	60	8	−2	30	----	1,214	18	72	5.22	+4.0	1.40	11	1	13.7	2.0	10.3	nw.	29	sw.	5	7	3	21	7.6	37
St. Joseph [2]	967	5	51	991.2	1,022.3	+1.6	31	15	23.0	−2.5	55	8	−8	30	----	1,306	16	77	4.55	+3.3	.90	14	1	12.3	3.0	12.9	e.	30	w.	5	5	7	19	7.3	39
Springfield, Mo. [2]	1,324	5	50	974.3	1,021.7	+.7	40	24	32.0	−.3	66	8	0	30	----	1,025	26	82	4.18	+1.8	.95	15	1	1.9	1.0	12.8	s.	42	sw.	27	3	5	23	8.3	25
Topeka [4]	987	65	87	989.2	1,022.8	+1.8	32	16	24.2	−3.4	58	8	−4	30	----	1,265	17	79	6.10	+5.2	1.87	12	2	12.4	3.0	9.5	n.	30	nw.	28	7	5	19	7.0	34
Lincoln [4]	1,189	6	81	977.3	1,022.6	+1.9	24	8	16.5	−6.3	42	7	−7	29	----	1,503	11	78	3.70	+3.1	1.39	10	1	15.9	9.0	10.7	nw.	33	nw.	4	7	4	20	6.8	40
Norfolk, Nebr. [2]	1,551	5	38	963.4	1,022.4	------	20	2	10.9	−9.7	42	7	−17	21	----	1,678	6	76	2.33	+1.7	1.28	11	0	8.7	16.0	----	n.	--	------	--	9	8	14	6.0	--
Omaha [2]	1,105	5	68	985.1	1,022.7	+1.7	26	9	17.4	−3.5	49	7	−10	30	----	1,483	11	77	3.70	+3.0	1.32	11	2	17.5	13.0	13.4	nw.	40	nw.	16	9	4	18	6.6	42
Valentine	2,598	46	54	925.5	1,023.4	+2.7	19	−2	8.6	−10.3	43	7	−28	21	----	1,751	3	77	.90	+.4	.56	7	0	12.2	12.0	10.7	w.	42	n.	4	9	5	17	6.4	62
Sioux City [2]	1,138	5	40	980.0	1,022.7	+1.7	22	4	13.2	−3.1	46	7	−15	29	----	1,606	8	79	2.44	+1.7	1.09	11	0	10.5	10.0	12.5	nw.	40	nw.	16	9	6	16	6.3	49
Huron [2]	1,301	5	41	972.9	1,023.0	+1.7	18	−2	7.7	−3.6	47	7	−34	21	----	1,776	3	77	.97	+.4	.62	11	0	17.1	8.0	13.8	nw.	43	nw.	16	8	6	17	6.6	36
NORTHERN SLOPE																																			
									6.6	−13.0								70	1.21	+0.6														5.9	
Billings [2]	3,570	16	39	893.7	1,025.1	+5.1	19	0	9.2	−13.2	52	6	−27	25	----	1,729	0	65	1.55	------	.41	10	0	23.1	11.0	12.5	sw.	36	n.	15	10	7	14	5.9	51
Butte	5,533	44	58	829.3	1,030.5	------	13	−17	−1.8	−16.2	44	7	−39	20	----	2,069	7	76	.50	+.1	.14	13	0	6.4	9.0	7.0	s.	--	------	--	13	4	14	5.3	--
Glasgow	2,086	34	53	946.5	1,027.0	------	14	−10	2.4	−6.6	48	7	−28	21	----	1,946	6	66	.37	−.1	.11	8	0	5.4	5.0	----	------	--	------	--	9	7	15	5.9	--
Great Falls [2]	3,657	16	75	891.0	1,025.0	------	20	0	10.0	−13.9	50	7	−29	20	----	1,703	1	66	1.40	+.8	.54	14	0	15.8	11.0	17.1	sw.	60	sw.	6	13	7	11	5.0	68
Havre	2,507	11	67	932.6	1,027.8	+7.8	16	−9	3.2	−9.7	51	7	−34	25	----	1,911	0	82	.44	−.3	.19	9	0	8.3	5.0	8.8	w.	42	sw.	6	13	5	13	5.3	52
Helena [2]	4,124	5	43	877.4	1,030.9	+9.9	12	−11	0.6	−18.1	48	7	−34	20	----	1,908	7	69	.66	+.1	.27	9	0	13.8	9.0	6.6	w.	29	s.	7	11	8	12	5.4	67
Missoula [2]	3,263	4	32	907.9	1,030.4	+5.7	16	−6	4.5	−14.1	45	7	−25	25	----	1,878	2	74	.34	−.5	.12	10	0	6.0	10.0	4.8	ese.	35	w.	7	11	5	15	5.9	53
Kalispell	2,973	48	56	918.4	1,029.6	+8.9	15	−2	6.6	−13.8	48	7	−24	20	----	1,813	2	67	1.07	−.5	.21	16	0	21.4	15.0	4.9	w.	26	sw.	7	6	9	16	6.5	41
Miles City [2]	2,371	5	28	938.0	1,026.9	+5.6	13	−9	2.2	------	47	7	−33	25	----	1,945	5	--	.76	------	.25	16	0	12.0	12.0	9.7	wnw	--	------	--	10	3	18	6.5	--
Rapid City [2]	3,259	5	56	903.8	1,023.6	+2.6	20	−2	8.8	−11.2	55	7	−25	20	----	1,739	1	73	1.68	+1.2	.60	12	0	24.0	9.0	19.1	n.	73	nw.	4	8	9	14	6.1	63
Cheyenne [2]	6,094	22	40	806.6	1,020.7	+1.7	26	2	14.1	−11.4	51	13	−16	24	----	1,578	4	65	2.78	+2.4	1.41	8	0	15.1	4.0	15.6	w.	66	nw.	4	11	7	13	5.3	51
Lander [2]	5,352	6	30	827.3	1,026.4	+4.4	11	−8	1.4	−16.9	35	14	−31	24	----	1,975	−7	67	1.65	+1.1	.46	14	0	23.9	15.0	4.3	se.	26	sw.	14	6	14	11	6.1	56
Sheridan [2]	3,790	5	38	879.8	1,024.7	+4.0	19	−4	7.4	−11.9	51	7	−28	24	----	1,785	−2	65	1.61	+.8	.48	13	0	22.9	12.0	10.5	nw.	45	nw.	2	8	7	16	6.4	51
North Platte [2]	2,821	11	51	919.1	1,023.1	+2.1	21	0	10.6	−12.3	40	7	−16	21	----	1,684	3	70	2.19	+1.8	1.37	10	0	21.8	6.0	13.0	n.	57	n.	3	7	9	15	6.5	53
MIDDLE SLOPE																																			
									23.8	−7.2								72	3.49	+2.7														6.6	
Denver [4]	5,292	106	113	834.1	1,020.7	+2.1	30	9	19.4	−10.4	57	7	−7	29	----	1,409	6	67	1.46	+1.1	.54	10	0	22.2	2.0	7.3	s.	30	n.	3	14	6	11	4.9	64
Pueblo [2]	4,690	5	36	850.7	1,020.5	+1.9	34	7	20.4	−8.3	61	7	−13	30	----	1,382	7	62	.27	.0	.09	7	0	3.6	1.0	6.9	w.	49	n.	2	9	10	12	5.6	49
Concordia	1,392	50	58	969.5	------	------	27	11	19.2	−7.2	49	7	−1	29	----	1,419	----	--	2.16	+1.6	.64	10	1	9.4	3.0	----	n.	--	------	--	8	7	16	6.4	45
Dodge City [2]	2,509	5	58	926.2	1,021.4	+.4	31	12	21.6	−7.4	60	8	−3	29	----	1,342	14	76	1.96	+1.6	.85	11	0	10.3	1.0	18.9	n.	56	nw.	5	7	7	17	6.8	44
Wichita [2]	1,358	52	64	969.5	1,021.9	+1.2	32	16	23.6	−7.7	58	2	−6	30	----	1,280	17	73	6.29	+5.5	1.75	14	1	19.6	4.0	16.8	s.	39	n.	28	7	4	20	7.3	37
Oklahoma City [4]	1,214	10	47	973.6	1,022.2	+1.5	39	22	30.6	−5.8	68	8	3	30	----	1,069	22	78	5.64	+4.4	1.26	14	0	15.9	5.0	10.6	n.	26	sw.	8	7	1	23	7.5	33
Tulsa [2]	674	10	60	996.6	1,022.1	------	41	23	32.0	−3.3	70	8	−6	30	----	1,023	25	79	6.65	+5.0	1.73	16	2	10.8	7.0	12.4	n.	45	sw.	15	5	4	22	7.7	36
SOUTHERN SLOPE																																			
									34.1	−8.0								73	2.29	+1.6														7.3	
Abilene [2]	1,755	4	59	957.3	1,021.2	+.9	45	26	35.4	−7.7	72	9	7	30	----	918	27	74	1.78	+.8	.44	18	0	4.0	T	12.8	n.	47	sw.	20	6	5	20	7.3	34
Amarillo [2]	3,604	5	42	892.0	1,020.1	+.8	37	16	26.7	−6.4	61	7	−3	30	----	1,184	18	75	2.04	+1.5	.67	14	1	8.6	3.0	15.5	sw.	45	sw.	8	7	5	19	7.1	43
Del Rio	960	63	71	885.1	1,019.8	+.5	54	38	46.0	−6.3	76	9	17	31	----	593	36	73	2.02	+1.5	.77	14	1	1.2	T	8.4	nw.	23	n.	3	4	6	21	7.5	30
Roswell	3,614	6	29	892.0	1,020.1	+1.1	40	17	28.4	−10.8	65	23	−15	18	----	1,139	20	73	1.70	+1.2	.53	10	1	18.7	2.0	7.7	n.	42	s.	2	9	3	19	6.9	38
Wichita Falls	1,030	4	49	984.1	1,022.3	------	44	24	33.9	−9.0	75	8	11	30	----	964	24	72	3.92	+2.8	1.56	14	3	4.9	2.0	----	n.	--	------	--	3	7	21	7.7	--
SOUTHERN PLATEAU																																			
									36.6	−6.7								67	2.44	+1.6														6.1	
El Paso [2]	3,916	35	85	884.9	1,017.3	−1.0	44	28	36.1	−7.5	67	24	.8	5	----	899	28	73	1.84	+1.4	.60	15	1	8.3	0	9.2	se.	48	nw.	3	10	3	18	6.5	48
Albuquerque [2]	5,314	5	45	835.1	1,016.4	−2.6	40	21	30.3	−3.8	53	24	2	4	----	1,075	19	64	.61	+.2	.20	9	0	2.8	0	11.4	sse.	61	e.	16	6	8	17	6.8	52
Flagstaff	6,907	34	48	785.6	1,018.1	+.5	30	9	19.6	−7.8	44	7	−20	4	----	1,394	12	72	6.91	+4.7	1.33	17	0	10.8	50.0	7.7	n.	--	------	--	7	4	20	6.9	--
Phoenix [4]	1,107	39	87	977.3	1,017.8	+.2	54	36	44.6	−6.6	65	1	24	4	----	630	31	66	1.61	+.8	.73	10	1	T	.0	6.4	e.	29	w.	2	10	5	16	5.9	59
Tucson [2]	2,555	5	39	926.2	1,016.6	−.7	52	34	43.0	−6.1	68	12	16	4	----	683	29	62	1.19	+.3	.41	7	0	4.7	.0	8.7	se.	40	sw.	23	9	8	14	5.8	54
Yuma	142	9	54	1,010.2	1,018.0	+.3	56	36	45.8	−8.6	67	1	28	30	----	592	28	--	2.46	+2.0	1.44	6	0	.0	.0	7.2	nw.	32	nw.	29	15	6	10	4.7	57

See footnotes at end of table

District and station	Elevation of instruments: Barometer above sea level [1]	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station	Pressure: Sea level	Pressure: Departure from normal	Temperature of the air, Averages: Mean maximum	Averages: Mean minimum	Averages: Mean	Averages: Departure from normal	Extremes: Highest	Date	Extremes: Lowest	Date	Extremes: Greatest daily range	Total heating degree days	Mean temperature of the dew point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Greatest in 24 hours	Days with 0.01 inch or more	Days with thunderstorms	Total snowfall (unmelted)	Snow, sleet, and ice on ground at end of month	Wind: Average hourly speed	Wind: Prevailing direction	Speed fastest mile: Miles per hour	Speed fastest mile: Direction	Speed fastest mile: Date	Character of day (sunrise to sunset) number of days: Clear	Partly cloudy	Cloudy	Sky cover [7] tenths (sunrise to sunset)	Possible sunshine
MIDDLE PLATEAU	Ft.	Ft.	Ft.	Mbs.	Mbs.	Mbs.	°F.	°F.	°F.	°F.	°F.		°F.		°F.		°F.	%	In.	In.	In.			In.	In.	m. p. h.					0-3	4-7	8-10	0-10	%
									11.9	-14.9								72	1.25	+.2														5.7	
Ely [2]	6,262	8	41				19	-8	5.8	-17.1	37	7	-27	25	----	1,836	----	--	.78	-.2	.24	11	0	16.7	11.0	12.4	s.	47	se.	21	12	7	12	5.7	53
Reno [2]	4,527	20	52	867.6	1,026.6	+5.3	30	-2	14.0	-16.9	42	8	-16	25	----	1,577	6	69	.76	-.8	.33	11	0	14.4	3.0	4.9	s.	36	w.	21	13	7	11	5.0	60
Winnemucca	4,339	5	56	870.3	1,026.6	+3.9	23	-5	9.0	-19.6	40	1	-28	25	----	1,734	1	68	1.06	.0	.39	10	0	19.2	8.0	8.0	ne.	30	ne.	9	10	12	9	5.2	67
Salt Lake City [2]	4,357	32	58	872.7	1,024.6	+2.2	22	1	11.6	-15.9	36	1	-22	25	----	1,658	7	80	2.31	+1.3	.71	15	0	30.1	17.0	6.8	s.	29	w.	1	9	6	16	6.2	58
Grand Junction [2]	4,602	5	26	851.3	1,022.0	+1.0	28	10	18.9	-5.1	46	13	-7	8	----	1,428	12	72	1.33	+.7	.47	12	0	18.2	6.0	5.1	e.	31	w.	23	8	6	17	6.4	54
NORTHERN PLATEAU																																			
									10.8	-16.9								73	.54															5.6	
Baker [4]	3,471	36	54	901.1	1,029.9	+7.2	18	-3	7.4	-17.6	33	1	-23	25	----	1,785	1	--	.20	-1.2	.06	7	0	7.2	15.0	5.4	se.	22	s.	11	10	12	9	5.0	53
Meacham	4,056	7	28	879.8	1,026.9	------	20	4	12.4	------	31	17	-12	10	----	1,631	8	81	1.48	------	.28	14	0	24.5	54.0	6.4	se.	--	------	--	7	5	19	7.2	--
Boise [2]	2,739	5	49	926.9	1,028.9	+5.2	20	1	10.3	-17.6	36	1	-7	20	----	1,692	4	76	.12	-1.6	.07	4	0	4.3	2.0	8.3	se.	31	nw.	1	15	4	12	4.9	69
Lewiston	1,436	4	23	974.6	1,029.7	------	23	6	14.3	------	40	6	-9	11	----	1,571	6	69	.42	------	.19	9	0	6.2	4.0	5.2	e.	--	------	--	6	7	18	6.8	--
Pocatello [2]	4,478	5	31	865.2	1,028.3	+5.3	16	-6	4.8	-17.5	36	1	-31	25	----	1,867	1	72	1.26	-.1	.36	13	0	21.3	20.0	7.2	sw.	38	sw.	1	9	7	15	6.2	56
Ellensburg [2]	1,735	5	58	963.1	1,030.3	------	19	-5	7.0	-18.5	38	7	-23	10	----	1,795	1	74	.37	-1.0	.16	6	0	7.2	19.0	5.2	e.	--	------	--	13	8	10	4.9	--
Spokane [2]	1,929	6	51	956.0	1,028.8	+7.8	18	-1	8.5	-19.0	38	7	-15	25	----	1,750	19	73	.50	-1.7	.23	9	0	6.4	19.0	4.3	ene.	36	sw.	7	12	9	10	5.0	53
Walla Walla	991	57	65	987.5	1,029.6	+16.9	24	11	17.6	-15.1	53	7	-3	25	----	1,471	10	--	.34	-1.6	.13	6	0	3.8	2.0	3.6	s.	23	w.	7	7	8	16	6.6	51
Yakima [2]	1,076	4	54	988.5	1,030.2	+9.2	29	1	14.6	-12.8	44	15	-11	24	----	1,564	5	69	.13	-.8	.09	3	0	2.5	4.0	5.8	w.	--	------	--	17	6	8	4.1	--
NORTH PACIFIC COAST																																			
									29.5	-8.3								77	1.12															5.9	
Kelso [2]	750	38	76	------	------	------	36	18	27.4	------	45	30	4	24	----	1,170	23	83	1.09	------	.25	9	0	13.5	2.0	5.4	sse.	--	------	--	5	7	19	7.0	--
North Head	211	5	55	1,017.6	1,025.8	+8.2	40	30	34.9	-7.2	46	6	21	24	----	927	26	72	1.63	-7.2	.41	15	0	9.8	T	10.4	e.	49	nw.	7	10	6	15	5.0	60
Seattle [4]	125	90	321	1,021.7	1,026.7	+8.4	39	28	33.6	-7.2	51	6	20	9	----	975	25	79	1.43	-3.5	.87	9	0	7.0	.0	7.0	se.	38	s.	6	8	6	17	6.5	41
Tacoma	194	172	201	1,019.3	1,026.8	+8.2	38	26	32.0	-7.0	52	6	15	10	----	1,024	----	--	.66	-5.5	.22	8	0	7.4	1.0	6.1	sw.	26	sw.	7	9	11	11	5.6	49
Tatoosh Island	86	5	61	1,023.0	1,026.2	+10.3	40	33	36.6	-4.6	47	15	28	24	----	880	30	77	1.84	-10.0	.78	11	0	6.2	T	14.2	e.	47	s.	6	10	8	13	5.9	57
Burns	4,162	35	47	876.4	1,027.0	------	22	-2	10.0	-14.6	36	30	-16	25	----	1,706	21	68	.16	-1.4	.06	4	0	2.7	6.0	4.4	n.	--	------	--	13	11	7	4.6	--
Eugene [2]	433	4	35	1,012.2	1,026.6	------	36	20	28.2	------	48	29	9	24	----	1,143	24	87	1.68	------	1.09	12	0	7.8	.0	5.8	n.	--	------	--	8	6	17	6.3	--
Medford [2]	1,329	29	58	976.0	1,026.3	+6.0	41	18	29.6	-8.3	52	29	5	24	----	1,008	21	76	.51	-1.8	.26	4	0	5.1	.0	3.2	n.	--	------	--	9	14	8	5.1	--
Portland, Oreg. [4]	154	68	106	1,021.3	1,026.1	+6.8	36	25	30.8	-8.6	46	15	17	25	----	1,066	20	72	.90	-5.7	.65	13	0	9.8	2.0	5.5	e.	18	ne.	24	9	8	14	5.8	52
Roseburg	510	45	76	1,007.1	1,026.4	+6.4	40	24	32.2	-9.0	52	18	11	10	----	1,018	27	80	1.35	-4.0	.91	11	0	6.0	.0	2.9	n.	16	n.	7	7	11	13	6.3	34
MIDDLE PACIFIC COAST																																			
									41.0	-6.2								61	1.42	-3.6														3.5	
Eureka	60	72	88	1,021.7	1,023.9	+3.6	48	33	40.3	-6.6	57	28	27	11	----	767	32	70	1.63	-5.5	.74	4	0	T	.0	7.2	n.	30	n.	8	15	9	7	4.2	74
Red Bluff [2]	353	5	26	1,009.1	1,022.4	------	50	29	39.4	-6.4	68	6	23	26	----	793	19	51	.39	-4.4	.17	4	0	1.5	.0	9.1	n.	40	n.	9	19	5	7	3.4	84
Sacramento [4]	66	92	115	1,020.3	1,021.2	+.9	48	30	39.4	-6.4	59	28	22	11	----	792	24	62	1.47	-2.2	1.11	4	0	.0	.0	8.7	nw.	30	nw.	9	18	7	6	3.4	74
San Francisco [4]	155	112	132	1,020.3	1,021.2	+1.2	51	39	44.7	-5.2	60	28	32	10	----	632	29	62	2.20	-2.3	1.51	5	0	T	.0	7.6	n.	29	n.	15	21	5	5	2.9	72
SOUTH PACIFIC COAST																																			
									44.7	-6.6								67	2.20	-.1														4.4	
Fresno [2]	327	5	34	1,010.2	1,021.2	+.2	51	28	39.6	-5.9	65	7	18	10	----	785	28	69	.60	-1.1	.36	4	0	T	.0	4.2	w.	34	nw.	2	17	7	7	4.1	79
Los Angeles	338	236	263	------	------	------	56	38	46.8	-7.8	71	6	28	4	----	562	----	--	2.43	-.7	1.06	11	1	.3	.0	8.2	e.	41	e.	16	15	6	10	4.2	74
San Diego [2]	87	20	55	1,016.9	1,018.7	+.4	56	40	47.8	-6.2	68	6	29	4	----	532	36	65	3.56	+1.5	1.30	15	0	T	.0	6.9	ne.	34	sw.	13	12	7	12	4.8	51
WEST INDIES																																			
San Juan, P. R.	82	9	54	------	1,013.5	------	78	70	73.8	-1.2	82	1	66	14	----	0	----	--	4.70	+.6	1.38	11	0	.0	.0	13.9	e.	34	e.	25	4	23	4	5.8	53
ALASKA																																			
Anchorage [2]	132	6	44	1,008.5	1,013.5	------	21	4	12.6	+1.0	38	9	-25	6	30	1,624	10	80	2.13	+1.3	.58	16	0	36.1	24.0	4.1	ne.	25	nw.	9	4	2	25	8.5	--
Annette Island	113	5	53	1,018.3	1,022.7	------	36	28	31.8	-4.0	44	5	12	23	17	1,032	29	85	9.98	-.5	3.19	17	0	14.0	3.0	11.9	ese.	--	------	--	5	5	21	7.6	--
Barrow	29	5	27	1,015.6	1,016.3	------	-4	-22	-13.1	+3.4	30	25	-43	1	42	2,421	-20	65	.17	.0	.06	7	0	1.8	14.0	11.9	se.	46	w.	23	9	11	11	5.3	--
Bethel [2]	28	5	31	1,009.8	1,011.2	------	15	0	7.3	+.4	36	8	-44	1	43	1,812	4	--	1.14	+.2	.30	13	0	11.6	23.0	----	sse.	--	------	--	7	4	20	7.0	--
Cordova [2]	45	5	32	1,009.8	1,011.5	------	33	17	24.8	-1.0	42	27	-15	7	41	1,237	24	89	14.21	+4.9	2.05	23	0	64.3	25.0	----	e.	32	se.	24	3	0	28	8.7	--
Fairbanks [2]	455	5	63	999.3	1,017.8	------	1	-18	-8.8	+2.5	28	31	-41	6	32	2,284	-15	72	.94	.0	.27	11	0	18.2	19.0	3.3	n.	18	sw.	5	8	5	18	6.5	--
Galena	139	4	66	1,009.1	1,014.2	------	1	-16	-7.3	+4.1	32	31	-48	5	39	2,232	-14	67	.71	+.1	.17	12	0	8.1	31.0	----	se.	40	e.	7	7	4	20	7.1	--
Gambell	32	5	32	1,007.1	1,008.1	------	15	4	9.2	+6.4	30	24	-16	3	26	1,730	6	85	.54	-.2	----	11	----	5.4	14.0	20.0	ne.	54	se.	22	4	5	22	8.0	--
Juneau [2]	80	6	30	1,019.0	1,020.0	------	31	20	25.6	+.4	41	5	0	7	24	1,227	22	84	7.33	+3.3	1.43	19	0	25.0	13.0	10.0	e.	41	se.	15	6	0	25	7.7	--
Kotzebue [2]	20	5	31	1,012.5	1,012.9	------	6	-8	-1.4	+6.5	29	31	-36	13	28	2,057	-6	76	.48	.0	.11	14	0	4.8	18.0	16.6	se.	49	se.	18	6	6	19	7.0	--
McGrath [2]	341	5	31	1,002.0	1,015.9	------	2	-20	-8.5	-1.2	35	31	-53	2	46	2,291	-14	65	2.13	+1.0	.68	11	0	31.9	39.0	----	w.	36	s.	31	7	3	21	9.5	--
Nome [2]	22	10	75	1,010.2	1,010.8	------	12	-2	5.4	+2.0	32	8	-39	2	26	1,848	3	85	2.06	+1.0	.54	19	0	20.8	27.0	14.4	e.	61	e.	7	6	3	22	7.5	--
Northway [2]	1,718	5	32	952.9	1,020.3	------	-5	-24	-14.4	.0	20	11	-46	7	37	2,460	-21	65	1.71	+1.1	.73	12	0	29.9	48.0	3.6	nw.	--	------	--	3	3	25	7.7	--
HAWAII																																			
Honolulu [4]	38	86	98	1,013.5	------	------	75	66	70.5	-.4	78	24	61	31	----	0	----	--	11.22	+7.4	4.85	14	3	.0	.0	8.7	ne.	41	sw.	16	8	13	10	5.8	58

[1] Height of barometer cistern above mean sea level on Jan. 1, 1900, or when station was first established since Jan. 1, 1900. When station is moved to new location or airport, the pressure is reduced to the original elevation for homogeneity. These elevations do not represent the present station elevation in most cases.

[2] Data are from airport records. Pressures adjusted to original elevations according to note 1.

[3] Barometric, hygrometric, wind, character of day, and average cloudiness data from airport records; remainder from city office records.

[4] Barometric and hygrometric data from airport records, remainder from city office records.

[5] Barometric, temperature, degree day, and hygrometric data from airport; remainder from city office records.

[6] As of Jan. 1, 1949, relative humidity values at temperatures below 32° F. are expressed with respect to water rather than with respect to ice, as used prior to that date. Therefore, these hygrometric values before and after Jan. 1, 1949, cannot accurately be combined with necessary conversion.

[7] As of Jan. 1, 1949, "Sky cover" has been substituted for "Average cloudiness" to include smoke, snow, etc., in addition to clouds that obscure the sky.

NOTE.—Unless otherwise indicated, data in table are city office records.

SEVERE LOCAL STORMS FOR JANUARY 1949

[The table hereunder contains such data as have been received concerning severe local storms that occurred during the month. A revised list will appear in the United States Meteorological Yearbook]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Idaho	1-3					Snow and wind	Snowfall throughout State on 1st, ranging up to 10 inches in Fremont County and a foot or more in Shoshone County, followed by strong winds in many sections. Drifting snow blocked highways 1 to 3 days in Fremont, Bingham, Jerome, and Gem Counties, and closed mountain highways in Boise County. Some delay in rail travel also.
Colorado, northeastern portion.	1-6	7 a. m., 2d-4 a. m., 6th.		7		do	Severe principally in Weld, Logan, Larimer, Morgan, Washington, and Yuma Counties. Winds reached gale force over most of eastern plains. Heavy snow fell over western areas, but wind velocities were moderate. Snowfall over the eastern portion varied from light to 15 inches. Drifting snow caused most damage and losses. About 3,000 head of cattle and 2,000 sheep perished in Colorado; subsequent losses may double these immediate estimates. Transportation halted in storm area for several days; many cars marooned on highways. Estimate of losses in vicinity of Agate, $500,000; Fairplay, $3,500; Fleming, $15,000; Ovid, $120,000; Stratton, $10,000; Windsor, $150,000. Heavy losses in vicinities of Ault, Grover, Nunn, Pierce, Rockport, and Sterling, and light to moderate losses in many other vicinities; not estimated. Some damage to winter wheat. Loss of life: Ault, 4, Fairplay, 1, and Idalia, 2.
North Dakota, north-central and southeastern portions.	1-31					do	Heavy snowfall and high winds; much blowing and drifting of snow. Continuous cold weather after 15th. Highways snow-blocked; many farmers and some towns isolated. Emergency medical care and food supplied by airplane. Much difficulty feeding livestock.
Wyoming	2-4			12	$9,000,000	Blizzard	Worst in climatological history of State. All transportation halted; several thousand travelers stranded. Railroads and highways blocked, with drifts 20 to 30 feet high. 12 deaths attributed directly or indirectly to storm. Livestock loss approximately $9,000,000. Loss in sheep averaged from 3 to 5 percent and cattle 2 to 4 percent.
Montana	2-31					do	In eastern third of State on 2d, in northeast on 8th, and in parts of entire area east of Divide on 18th. High winds on several dates kept most secondary roads blocked most of time; several main highways closed for periods up to 2 days. Sheep loss 5 percent. Extremely cold weather which persisted throughout month, especially in western half, caused severe water service difficulties in several cities and delayed transportation. Flathead Lake froze over late in January for 3d time since the 1880's.
Nebraska, western and central portions.	2-5					do	Worst experienced in State, with reference to force of wind, amount of snow and drifting, and duration of severe conditions. Even worse than storm itself were conditions that followed. Winds redrifted snow over roads many times. Ice mixed with snow made use of ordinary equipment for snow removal limited. Private, county, State, and Federal agencies worked continually for many days. Losses to railroads immense. Livestock losses estimated at 4 percent; this may require revision as reports come in. Relief operations, and opening and reopening of roads requiring expenditures running into the millions. Several lives lost.
South Dakota	2-31				1,000,000	Snow and wind	Snowfall 7 to 25 inches over State from 2d to 5th. Ninth lowest January temperature average. Winds 50 to 70 m. p. h. from 2d to 5th in western portion were high during entire month, except for brief periods; lesser force in east and northeast. Lighter snows and drifting at intervals during month, with near record low temperature on 21st made a critical situation west of the Missouri River for evacuation of livestock plus undetermined health of those surviving.
Wilson and Neosho Counties, Kans.	3	2 p. m	100-200	0	120,000	Tornado	Originated 4 miles northeast of Altoona; traveled northeastward, striking town of Vilas; ended a short distance southwest of Petrolia. Path about 15 miles long. 1 person injured. 7 houses destroyed, 13 damaged; 21 other buildings destroyed, 14 damaged. 13 miles of telephone and power lines damaged.
Anderson County, Kans	3	2:30-3 p. m	100	0	45,000	do	Traveled from near Colony to near Bush City, passing near south edge of Lone Elm. Path about 25 miles long. Damage to rural property. 2 residences demolished; many other farm buildings destroyed, or damaged. Cattle killed. Telephone and power lines blown down.
Caddo, Webster, and Claiborne Parishes, La.	3	2:45-4 p. m	100-500	1	140,000	do	Developed near Dixie and moved northeastward through Webster and Claiborne Parishes into Arkansas, later striking El Dorado and Warren, Ark. It lifted occasionally, striking Sarepta and Gordon (near Haynesville). 7 persons seriously injured at Gordon and 14 at Sarepta. 20 homes and 9 other buildings destroyed; 8 homes and 3 other buildings seriously damaged. Tornado followed closely path taken by Dec. 31, 1947, tornado. Attended by light hail in Haynesville.
Franklin County, Kans	3	3-3:30 p. m	200	0	500	do	Vortex cloud first seen high in air about 1 mile southwest of Richter, 6 miles west of Ottawa. Path ended 2 miles northeast of Richter. The long, rope-shaped cloud touched ground occasionally. Damaged barns and other farm buildings.
Columbia, Union, Ouachita, Calhoun, Bradley, Drew, and Lincoln Counties, Ark.	3	3:15-6 p. m	300-500	57	1,317,920	do	Near record high temperatures for January in southern half of State and in northern Louisiana, followed by cold air mass from northwest. 3 separate tornadoes formed and moved northeastward across southern half of State. The first, and most severe, first sighted 10 miles north of Shreveport at 3:15 p. m.; traveled northeastward for 145 miles in 2¾ hours. Made numerous contacts with ground. At Hopewell, 8 miles west of El Dorado, 2 persons were killed and 18 injured. It struck the Bradley Lumber Mill and Bradley Employees Community west of Warren, then lifted to drop again on the northeast side of Warren. In Warren area 55 deaths and 400 injuries; 120 homes destroyed, also 72 suffered major damage, 150 minor damage, and 300 slight damage. Tornado last reported near Lincoln-Desha County line at 6 p. m. 2,700 acres of timber damaged in 5 separate contacts. Quick action by relief agencies materially lessened suffering. Damage to business and manufacturing, $600,000; other property, $633,500; forests, $84,420.
Dallas, Cleveland, and Grant Counties, Ark.	3	4-5 p. m	100-200	0	15,700	do	Struck in Dallas County and traveled about 50 miles northeastward, making occasional contacts. Most damage at Grapevine, where 2 persons severely injured and 4 homes completely destroyed. Several cars and trucks damaged. Property damage, $14,200; timber, $1,500.
Hot Springs, Garland, Saline, and Pulaski Counties, Ark.	3	4-5 p. m	100-200	0	12,000	do	Travelled about 60 miles northeastward. Deflection by hill country probably reduced potential destruction. Damage minor and scattered. First reported northwest of Arkadelphia, and last contact at Pulaski County Penal Farm, near Pinnacle Mountain. Property damage, $10,000; timber, $2,000.
Lincoln and Union Parishes, La.	3	near 5 p. m	50	1	95,000	do	Moved northeastward in short path. Choudrant and Downsville seriously affected. 19 homes and 11 other buildings destroyed; 4 homes and 2 other buildings damaged. 14 persons injured seriously.

SEVERE LOCAL STORMS FOR JANUARY 1949—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Nebraska, central and northeast portions.	3		[1] 100			Ice	Many communities isolated for a few days because of breakage of power and communication lines. Ice ½ to 1 inch thick on wires.
Minnesota, west-central, southwestern, and northeastern counties.	3-5				75,000	Ice, sleet, snow, and wind.	Many poles and wires down; communication and electric services seriously disrupted. Traffic delayed. Many trees and shrubs damaged. Some schools closed for several days. Thickness of ice on wires varied from ⅛ to 2 inches; began to form about 3 p. m. of 3d in extreme southwest and remained on wires in some localities until 7th. Heaviest ice formation west and southwest of Willmar. Damage to overhead wire-system caused by unusual weight of ice and high winds; about 420 poles down and about 6,076 wire breaks, resulting in about $75,000 loss. Heavy snows in west-central, north-central, and northeast. Some telephone wires down near Virginia.
Idaho	7					Drifting snow	Highways blocked, particularly those running north-south, at such widely separated points as Albion, Springfield, Eden, Nezperce, and Forney. Rail travel delayed.
Kansas, southeastern portion.	9-11	Forenoon of 9th to afternoon of 11th.	[1] 100		1,000,000	Ice and sleet	Especially severe at Parsons, Independence, Columbus, and Pittsburg. Power and telephone lines practically all down in those cities, paralyzing activities. Schools closed; business houses not opened; homes lighted by candles; and some without heat. Service not fully restored for more than a week. Loss to telephone lines, $380,000; to power lines, $125,000.
Mount Sterling and vicinity, Ill.	9-12					Ice	Automobile damaged by falling tree limb. Several persons injured by falls on ice.
Quincy and vicinity, Ill	9-12					do	Telephone and electric power services disrupted by broken lines.
Roodhouse and vicinity, Ill	9-12					do	Considerable damage to trees, electric and telephone wires.
Pittsfield and vicinity, Ill	9-12					do	Heavy damage to trees, telephone and power wires. Several injuries due to falls on ice.
Barry and vicinity, Ill	9-11					do	Telephone and electric lines downed. Several people injured in falls.
Beardstown and vicinity, Ill.	9-12				250,000	do	Telephone and power wires broken. 20 persons injured in falls.
Iowa, southern portion	10	Afternoon and evening.				Ice and sleet	Freezing rain, sleet, and snow covered most of south, ranging up to 3 inches. Highways hazardous. Small damage to telephone and power lines.
New Mexico, southeastern portion.	10-12				500,000	Ice	Freezing rain, principally in Roosevelt and Lea Counties, for several days coated trees, wires, and other exposed objects with ice up to 1 inch or more thick. Many telephone and power lines down; some communities without power, light, or heat for extended periods. Trees in some areas severely damaged.
West Virginia	11-12			2		Snow	3 small boys lost in storm near Davis; 2 dead when found and third in critical condition.
Fulton County, Ohio	13	During night			7,500	Wind	Walls of church, being erected, blown down; minor damage to roofs.
Idaho, south-central portion	15					Drifting snow	Highways blocked 1 to 2 days in Elmore, Gooding, Lincoln, Jerome, and Twin Falls Counties. Trains delayed.
Waterloo and vicinity, Ill	17-18	Night				Ice	Wires, poles, and trees damaged.
Beardstown and vicinity, Ill.	17-18				5,000	do	Damage to electric and telephone wires.
Albion and vicinity, Ill	18					do	Many telephone wires broken by ice.
Sparta and vicinity, Ill	18					do	Considerable damage to telephone and power wires.
East St. Louis and vicinity, Ill.	18			1	50,000	do	Heavy damage to telephone and electric lines; many poles downed. 1 man killed when his car skidded. Several persons injured in falls.
Quincy and vicinity, Ill	18					do	Telephone and electric lines broken.
Peoria and vicinity, Ill	18	Morning				do	Several persons injured in falls; many minor auto accidents.
White Hall and vicinity, Ill.	18	do		1		do	1 man died as a result of a fall on ice; 20 to 25 others injured. Trees badly damaged.
Aurora and vicinity, Ill	18					do	Many minor auto accidents due to slippery streets.
Orleans Parish, La	18	2:30 p. m.			6,000	Wind	Line squall with winds briefly up to 50 m. p. h. unroofed portion of Pelican stadium in New Orleans and a roller skating rink with damage to hardwood floors.
Caledonia, Miss	18	4 p. m.		2	100,000	Tornado	Path apparently very short. 17 persons seriously injured. 8 homes and 14 other buildings, including 2 cotton gins, destroyed; 11 homes and 13 other buildings seriously damaged.
Fort Wayne, Ind	18				200,000	Wind	Considerable structural damage. 70 m. p. h. gusts.
South Bend, Ind	18-19	Night			1,000	do	
Ohio	18-19	Evening of 18th, morning of 19th.				do	State-wide, but locally minor damage to roofs, windows, public utility lines, and trees.
Michigan, southeastern portion.	19	Early morning.		1	500,000	do	Southeastern communities suffered property loss when all-time wind velocity records broken. 1 death from falling tree at Flint. A fire burned 3 business places in Mason. Airplanes overturned at various airports. Plate glass windows blown in. Power and communication lines hard hit.
Nebraska, southern portion	22-23		[1] 150			Ice	General prostration of service in numerous sections because of damage to power and communication lines.
Iowa	23	Morning				Ice and fog	Freezing rain caused thin coat of clear ice on outdoor objects; in combination with heavy fog, highway and air transportation at standstill for 12 to 24 hours. Some schools closed following day. Several hundred breaks in telephone lines, particularly in west. Wildlife suffered.
Beavertown, Pa	23					Ice	Considerable damage to trees and limbs.
Iowa	27-28					Ice, sleet, and snow.	Early on 27th, 1 to 2 inches of mixed sleet and rain fell south of a line from Council Bluffs to Boone, Waterloo, and Dubuque. Objects covered with rough ice. Later in day, heavy snow and some wind. In northwest, near blizzard conditions. Except in extreme northwest and extreme southeast, 6 to 14 inches of new snow. Highway travel hazardous; most side roads impassable. Many schools closed on 28th.
Nebraska, eastern portion	27		[1] 200			Heavy snow, with blizzard.	Damage greater in snow-bound sections where crews opening roads and trails to feed supplies and cattle, and to farm houses.
Freeport and vicinity, Ill	27					Ice	Severe damage to telephone and power lines.
Oregon and vicinity, Ill	27					do	Considerable damage to trees, telephone and electric lines.
La Harpe and vicinity, Ill	27					do	Several power lines broken.
Harvard and vicinity, Ill	27					do	Trees, telephone and electric wires downed by ice.
Wilkes-Barre, Pa	27	Night				Ice and sleet	Ice felled numerous utility lines. Sleet-laden limbs fell, severing additional wires. Heavy damage to farms and orchards.
Seneca, S. C	31	During day		1		Freeze	Man frozen.

[1] Miles instead of yards.

SOLAR RADIATION DATA FOR JANUARY 1949

Explanation of tables 1 and 2 and references to descriptions of instruments, stations, and methods of observation, and to summaries of data, are given in the MONTHLY WEATHER REVIEW, volume 72, No. 1, January 1944, page 43. A list of pyrheliometric stations is given on page 45 of that issue. An explanation of the formula used in computing the air mass values for each station listed in table 1 appears in volume 75, No. 3, March 1947, page 47.

The order of stations listed in table 2 has been revised beginning with this issue. The new order is based upon increasing value of station latitude, starting with the lowest value.

TABLE 1.—*Solar radiation intensities during January 1949*

[Gram calories per minute per square centimeter of normal surface]

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
MADISON, WIS.											
	Air mass										
	4.81	3.84	2.88	1.92	*0.96	1.92	2.88	3.84	4.81		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
5	0.59	0.74	1.01							2.7	3.
6		1.02	1.19		1.60					2.9	4.2
7	.80	.91	1.01		1.34					5.1	6.1
8	.68	.76	.91		1.44					5.1	5.6
12		.86	1.06		1.50					3.7	3.7
13	.76	.94	1.13				1.07			2.6	3.8
14	.80	.92	1.04		1.37					3.7	5.1
19	.81	1.01	1.19		1.59					1.5	1.0
22	.94	1.01	1.16		1.35					.5	1.2
29	.98	1.11	1.25		1.57					.5	.6
Means	.80	.93	1.10		1.47		(1.07)				
Departures	−.09	−.09	−.07		−.06		−.07				
BLUE HILL, MASS.											
	Air mass										
	4.86	3.89	2.92	1.94	*0.97	1.94	2.92	3.89	4.86		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
3	0.92	1.04	1.21							2.7	3.9
4	.93									3.7	5.1
8	.62	.77						.77	0.63	5.9	6.3
13			1.14							2.7	2.1
15	.97	1.09	1.15					.74	.68	1.5	1.9
20	1.02	1.13	1.27					1.16	1.06	3.3	2.4
29	.87	.99	1.13					.92		3.2	2.5
30	1.07	1.16	1.27				1.26	1.11	1.00	.9	1.4
Means	.91	1.03	1.20				1.26	.94	.84		
Departures	−.03	−.01	+.05				+.09	−.09	−.08		

TABLE 1.—*Solar radiation intensities during January 1949*—Con.

Date	Sun's zenith distance									Vapor pressure	
	A. M.				0.0°	P. M.					
	78.7°	75.7°	70.7°	60.0°		60.0°	70.7°	75.7°	78.7°	7:30 a. m.[1]	1:30 p. m.[1]
CLIMAX, COLO.											
	Air mass										
	3.24	2.59	1.94	1.29	*0.65	1.29	1.94	2.59	3.24		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
6		1.32	1.40				1.38	1.24	1.22		
7							1.41	1.31	1.21		
8	1.29	1.37	1.45								
10			1.42				1.38	1.28	1.18		
11			1.43				1.47	1.36	1.27		
12	1.25	1.32	1.42								
13		1.20	1.33								
17	1.32	1.41	1.46				1.46	1.30	1.26		
19	1.30	1.38	1.46								
21	1.30	1.39	1.49	1.59							
22		1.35	1.42								
29				1.62		1.58	1.44	1.38	1.27		
Means	1.29	1.34	1.43	(1.60)		(1.58)	1.42	1.31	1.24		
Departures	+.01	.00	−.01	+.02		+.03	.00	.00	+.02		
LINCOLN, NEBR.											
	Air mass										
	4.77	3.81	2.86	1.91	*0.95	1.91	2.86	3.81	4.77		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
6	0.86	0.99	1.14				1.16	1.03	0.96	3.66	4.40
7	.92	1.03	1.16							4.40	5.89
15	.98	1.07	1.18				1.16	1.01		6.91	7.18
19	1.00	1.13	1.24							1.03	1.15
21							1.15	.98	.83	1.15	1.03
31							1.15	1.09	.98	1.58	3.66
Means	.94	1.06	1.18				1.16	1.03	.92		
Departures	+.01	+.01	−.01				−.03	−.02	−.02		
TABLE MOUNTAIN, CALIF.											
	Air mass										
	3.76	3.01	2.26	1.51	*0.75	1.51	2.26	3.01	3.76		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
5				1.56							
7				1.56							
8				1.49							
12				1.55							
27	1.22	1.32	1.42	1.55							
Means	(1.22)	(1.32)	(1.42)	1.54							
Departures	+.03	+.04	+.03	+.03							
BOSTON, MASS.											
	Air mass										
	4.96	3.96	2.97	1.98	*0.99	1.98	2.97	3.96	4.96		
January	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mb.*	*mb.*
3		0.84								3.5	4.0
4		.90	0.93							3.8	5.3
14		.45	.62							4.6	3.6
20	0.86	.93								3.5	2.5
Means	(.86)	.78	(.78)								
Departures	+.09	−.06	−.19								

*Extrapolated.

[1] 75th Meridian Time.

NOTE.—Figures in parentheses are interpolated.

TABLE 2.—*Daily totals and weekly means of solar radiation (direct+diffuse) received on a horizontal surface during January 1949*

[Gram-calories per square centimeter]

Date	Honolulu, T. H.	Pearl Harbor, T. H.	La Jolla, Calif.	Riverside, Calif.	Inyokern, Calif.	Nashville, Tenn.	Fresno, Calif.	Davis, Calif.	Washington, D. C.	Columbia, Mo.	Soda Springs, Calif.	Grand Lake, Colo.	New York, N. Y.	Salt Lake City, Utah	State College, Pa.	Lincoln, Nebr.	Newport, R. I.	Put-in-Bay, Ohio	East Wareham, Mass.	Blue Hill, Mass.	Boston, Mass.	Ithaca, N. Y.	Twin Falls, Idaho	East Lansing, Mich.	Madison, Wis.	Toronto, Canada	Summit, Mont.
1949	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Jan. 1	480	447	148	112	-----	39	184	87	181	55	39	106	93	74	82	112	51	247	56	-----	14	43	78	110	71	66	41
Jan. 2	410	449	246	255	-----	36	284	265	117	239	261	98	150	99	220	167	68	239	70	73	74	66	165	154	142	54	117
Jan. 3	475	436	268	293	355	13	270	275	215	46	295	163	178	117	193	2	214	161	190	175	129	46	209	172	55	105	186
Jan. 4	466	364	273	217	337	44	266	275	91	53	284	107	183	136	94	200	171	28	130	155	145	96	224	22	26	72	195
Jan. 5	434	368	275	248	343	42	267	264	11	295	278	157	17	158	20	175	15	19	24	13	12	7	200	58	127	1	46
Jan. 6	267	247	261	266	334	372	215	248	238	290	(360)	283	194	149	177	242	129	70	73	112	110	114	190	143	192	71	52
Jan. 7	313	358	268	258	335	261	257	210	237	190	272	284	173	147	219	225	182	186	155	172	152	66	205	26	192	56	15
Means	406	381	249	236	341	101	253	233	156	170	241	171	141	126	144	160	118	136	100	117	91	63	182	98	115	61	92
Departures	+8	+19	+9	−13	-----	−7	+104	+78	−3	+14	+21	-----	+27	−11	+42	−10	−16	+42	−32	−17	−4	−35	+36	+8	−13	−15	−25
Jan. 8	68	85	267	199	329	77	243	262	130	188	69	243	169	79	114	192	155	221	162	185	153	74	212	140	193	93	145
Jan. 9	342	298	182	192	241	198	249	276	129	37	235	220	106	88	172	38	70	206	95	88	74	83	216	118	68	112	179
Jan. 10	300	331	183	171	250	204	304	277	128	18	306	285	72	210	56	56	59	37	59	63	42	5	100	28	80	88	192
Jan. 11	441	395	87	156	165	104	208	269	139	-----	296	294	167	64	119	68	105	79	137	158	133	73	198	41	69	64	192
Jan. 12	415	398	169	248	278	37	301	134	91	34	225	296	86	115	75	204	97	62	104	104	87	28	126	18	198	54	198
Jan. 13	492	397	90	77	223	44	216	180	234	152	273	287	196	120	144	235	226	219	207	210	187	53	133	175	205	39	205
Jan. 14	474	383	118	133	353	48	247	189	210	76	(94)	158	105	222	32	154	131	77	144	176	151	24	85	23	233	191	71
Means	362	327	156	168	248	101	252	226	152	84	214	254	129	128	102	135	121	129	130	141	118	49	153	78	149	92	169
Departures	+18	+12	−93	−82	-----	−31	+90	+30	0	−62	−6	-----	+3	−16	−35	−46	−35	−3	−25	−15	+5	−62	−5	−19	+14	+13	+25
Jan. 15	439	393	181	279	305	120	284	282	155	89	(314)	146	134	-----	135	86	241	28	169	251	186	121	156	5	35	62	168
Jan. 16	30	20	295	323	380	178	286	288	223	51	319	274	158	262	91	196	186	54	151	182	136	13	229	44	107	50	146
Jan. 17	159	146	293	316	354	29	303	215	57	237	(167)	316	80	115	80	271	71	72	48	29	11	19	153	7	151	116	87
Jan. 18	80	79	139	176	280	136	100	119	51	33	171	258	140	240	12	44	38	16	54	36	10	41	235	T	51	35	134
Jan. 19	267	230	36	45	127	52	30	18	36	277	48	320	31	162	77	255	48	88	40	51	49	60	196	44	260	47	178
Jan. 20	350	323	96	104	188	286	251	92	262	114	(366)	127	266	252	273	45	256	149	236	297	216	104	250	118	108	142	186
Jan. 21	412	376	103	113	464	27	225	306	17	55	87	314	66	127	20	249	107	27	91	116	55	48	109	43	106	44	107
Means	248	224	163	194	300	118	220	188	114	122	210	251	125	193	98	164	135	62	113	137	96	58	190	37	117	71	144
Departures	−76	−81	−97	−88	-----	−29	+26	−40	−42	−43	−28	-----	+1	+16	−33	−23	−25	−72	−31	−21	−16	−56	+13	−84	−37	−1	−15
Jan. 22	428	455	100	58	335	99	249	204	235	84	235	237	221	101	225	82	200	238	179	256	180	86	174	179	260	133	218
Jan. 23	457	482	286	204	383	88	179	256	26	41	236	150	200	161	37	29	167	79	134	251	184	110	164	38	44	14	198
Jan. 24	429	460	124	280	324	170	213	316	103	56	333	340	45	191	34	150	25	79	19	49	13	10	295	14	143	5	237
Jan. 25	374	364	241	280	82	43	368	320	31	33	361	394	105	220	32	105	36	29	29	32	8	18	263	7	83	80	155
Jan. 26	463	491	307	333	358	41	364	270	9	93	(321)	298	23	256	19	145	53	34	62	70	21	20	251	46	65	45	86
Jan. 27	392	413	233	313	372	107	318	306	39	21	314	260	80	129	37	46	121	44	85	122	48	92	104	50	32	99	109
Jan. 28	508	440	308	300	425	61	315	332	132	150	372	217	19	298	209	269	14	36	16	27	7	42	238	41	199	14	246
Means	436	444	228	261	328	87	286	286	82	68	310	271	99	194	85	111	88	77	75	115	66	54	213	54	118	56	179
Departures	+58	+55	−34	+4	-----	−84	+70	+42	−94	−132	+38	-----	−56	−3	−73	−107	−80	−83	−78	−60	−69	−77	+31	−72	−62	−29	+19

ACCUMULATED DEPARTURES ON JANUARY 28, 1949

	+56	+35	−1405	−1253	----	−1057	+2030	+770	−973	−1561	+175	-----	−175	−98	−693	−1302	−1092	−812	−1162	−791	−588	−1610	+525	−1109	−686	−224	+28

TABLE 3.—*Daily totals and weekly means of solar and sky radiation plus the radiation reflectcd from the ground, as received on a vertical surface facing south at Blue Hill, Mass., during January 1949*

Date	1	2	3	4	5	6	7	Mean	8	9	10	11	12	13	14	Mean	15	16	17	18	19	20	21	Mean
Gm cal/cm²	8	89	415	347	13	289	445	229	540	137	89	431	164	417	296	296	489	262	11	13	22	542	52	199
Date	22	23	24	25	26	27	28	Mean	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
Gm cal/cm²	368	318	16	8	25	57	38	119	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

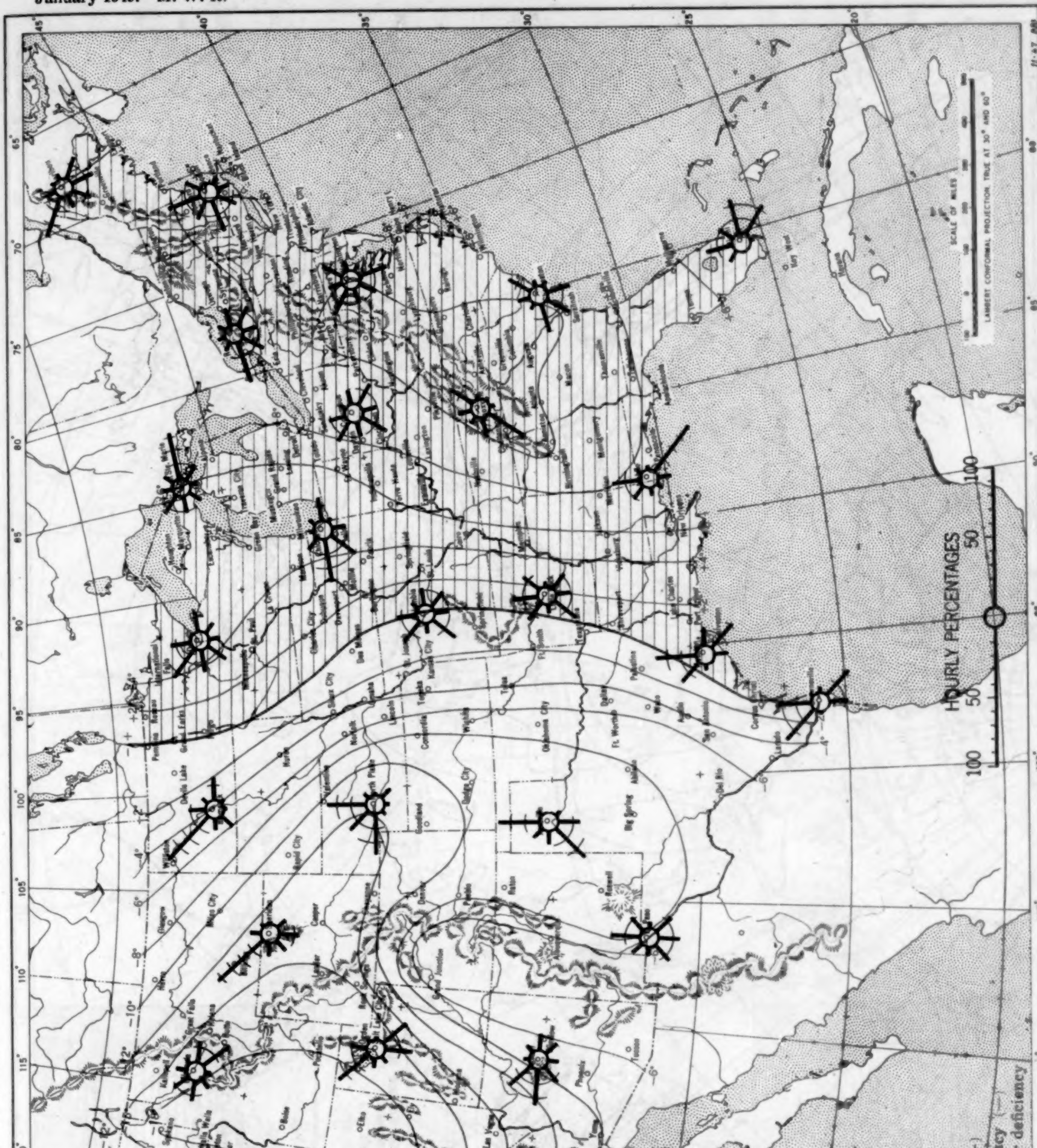
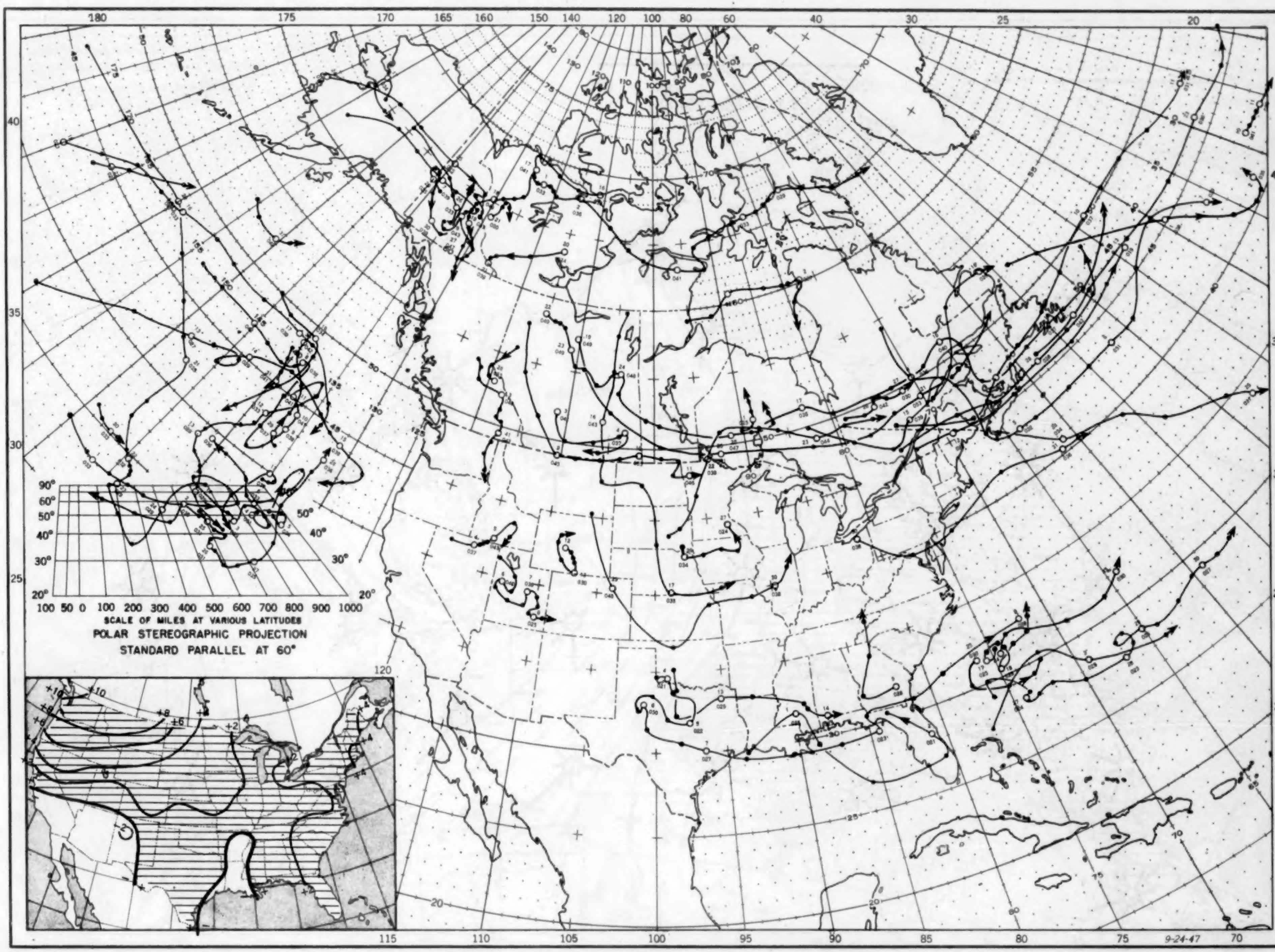


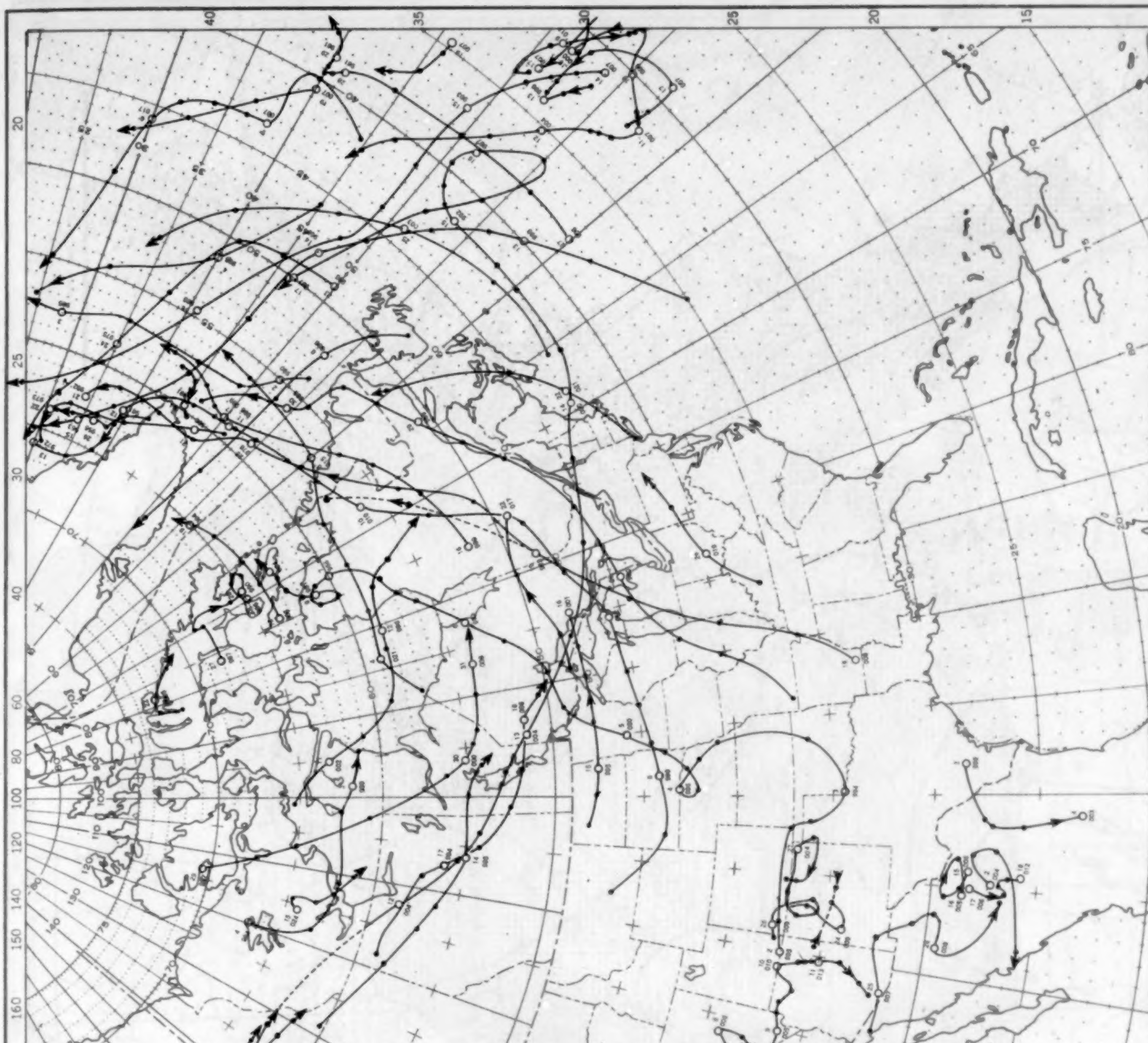
Chart I. Departure (°F.) of the Mean Temperature from the Normal, and Wind Roses for Selected Stations, January 1949

Chart II. Tracks of Centers of Anticyclones, January 1949. (Inset) Departure of Monthly Mean Pressure from Normal



Circle indicates position of anticyclone at 7:30 a. m. (75th meridian time). Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart III. Tracks of Centers of Cyclones, January 1949. (Inset) Change in Mean Pressure from Preceding Month



Circle indicates position of cyclone at 7:30 a. m. (75th meridian time) Dots indicate intervening 6-hourly positions. Figure above circle indicates date, and figure below, pressure to nearest millibar. Only those centers which could be identified for 24 hours or more are included.

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, January 1949

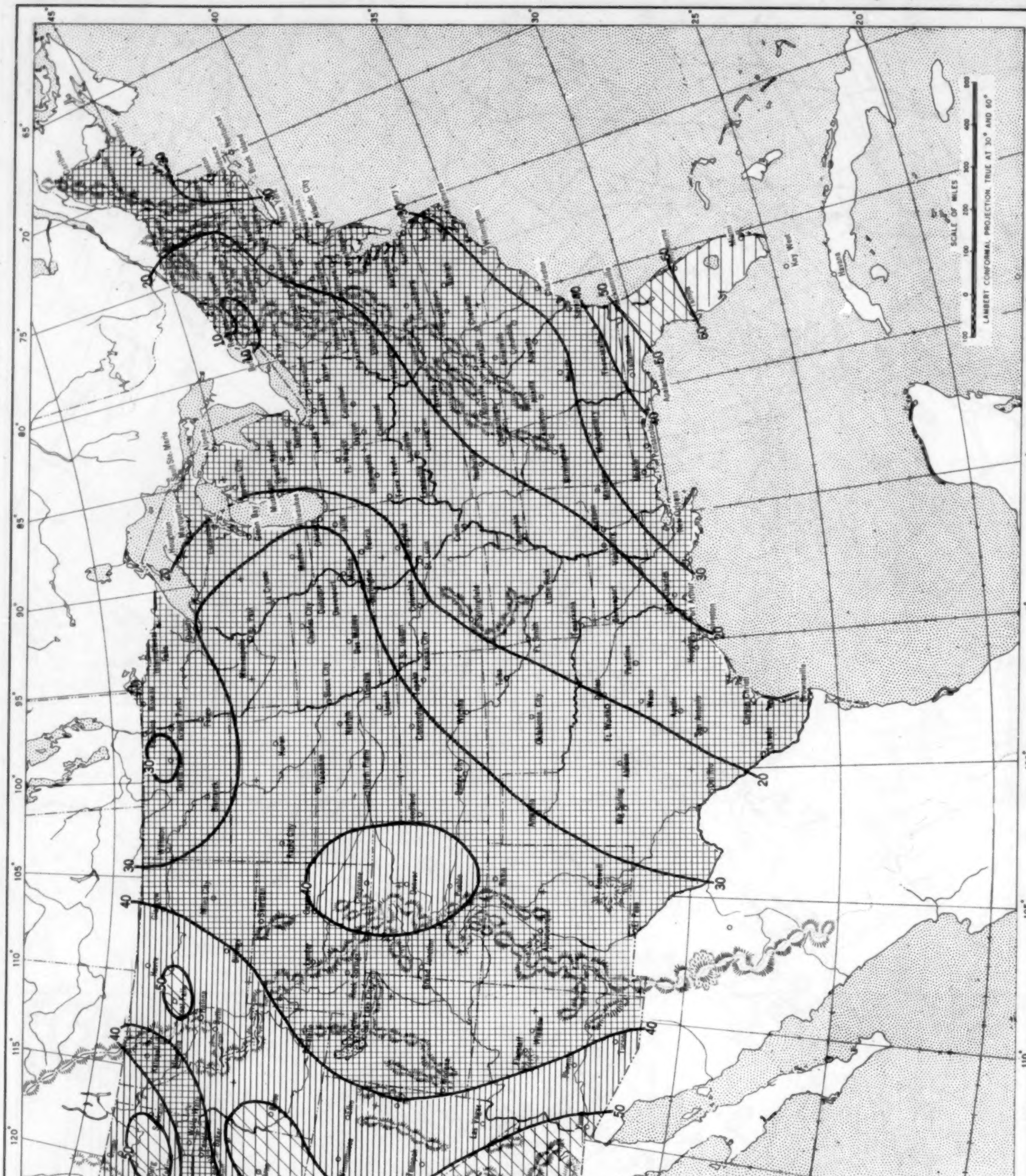
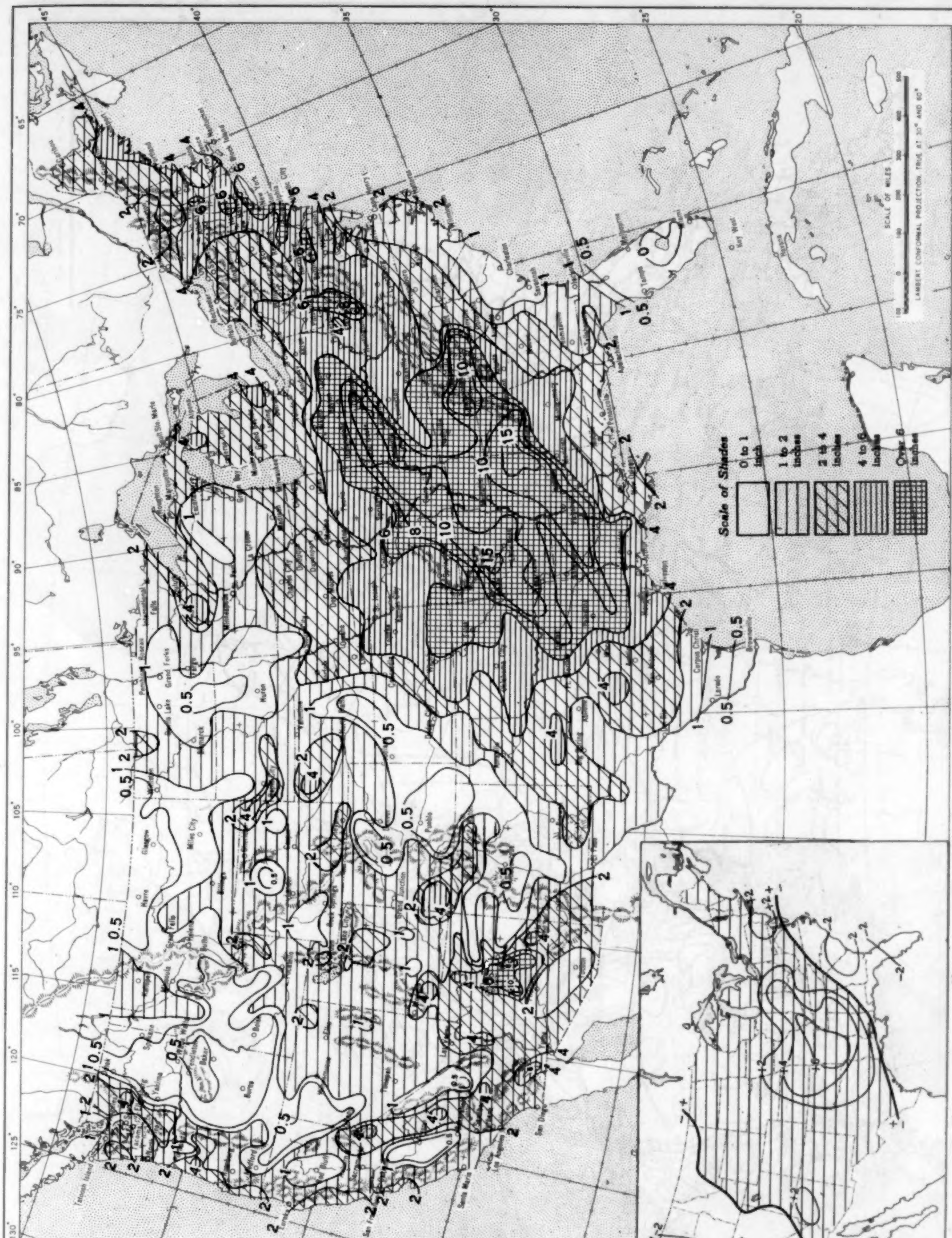


Chart V. Total Precipitation, Inches, January 1949. (Inset) Departure of Precipitation from Normal



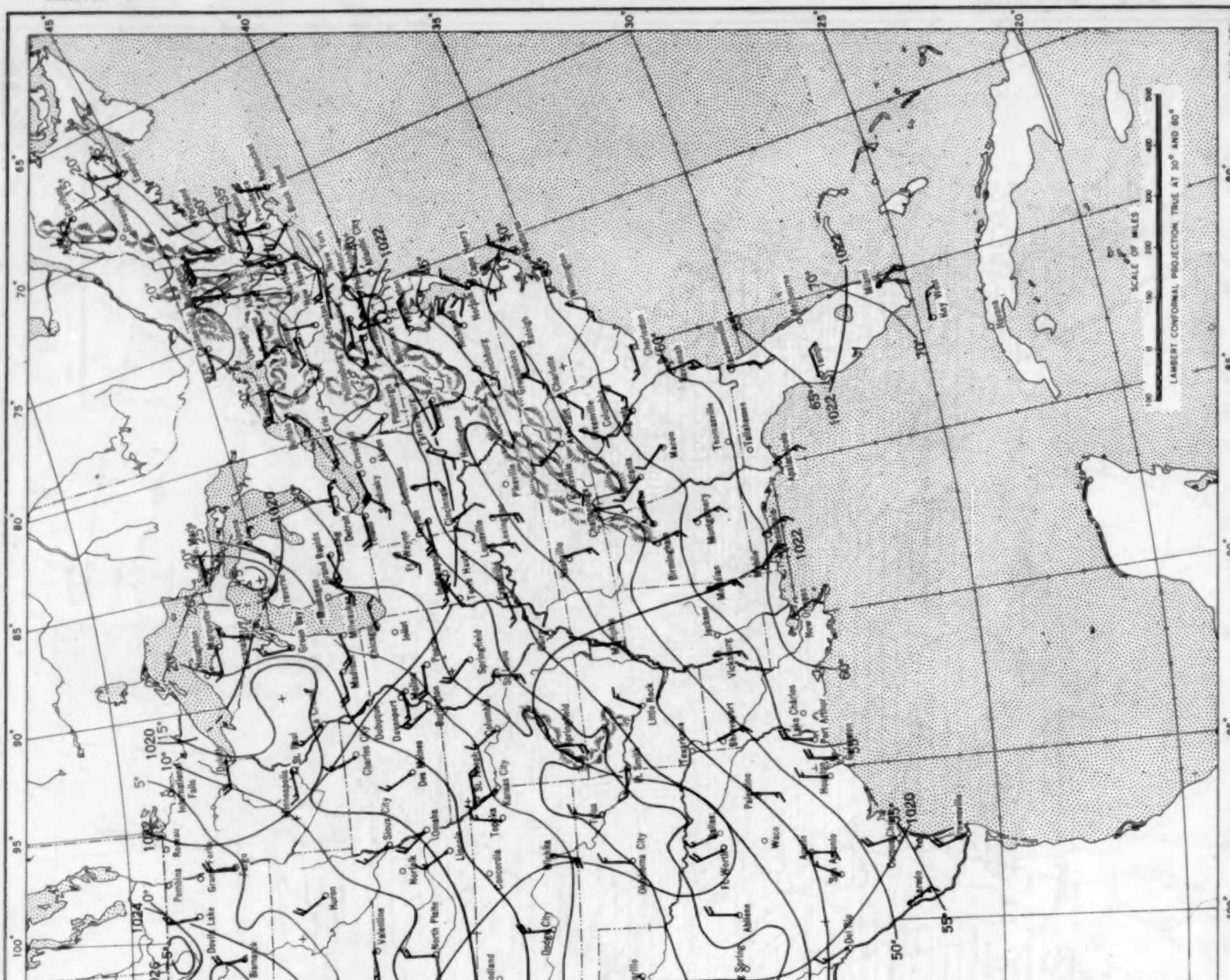


Chart VI. Isobars (mb.) at Sea Level and Isotherms (°F.) at Surface; Prevailing Winds, January 1949

Chart VII. Total Snowfall, Inches, January 1949. (Inset) Depth of Snow on the Ground at 7:30 p. m., January 31, 1949

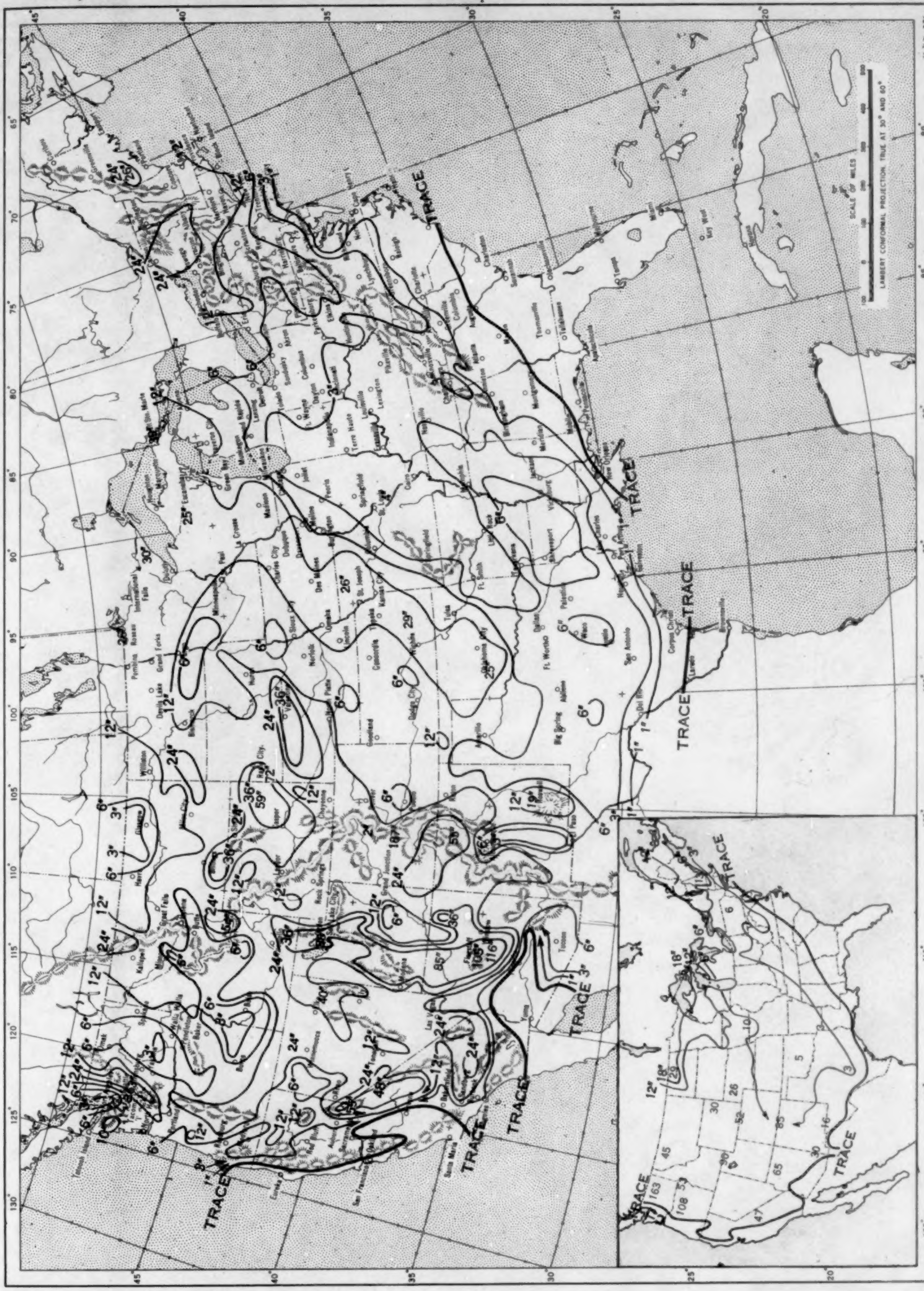
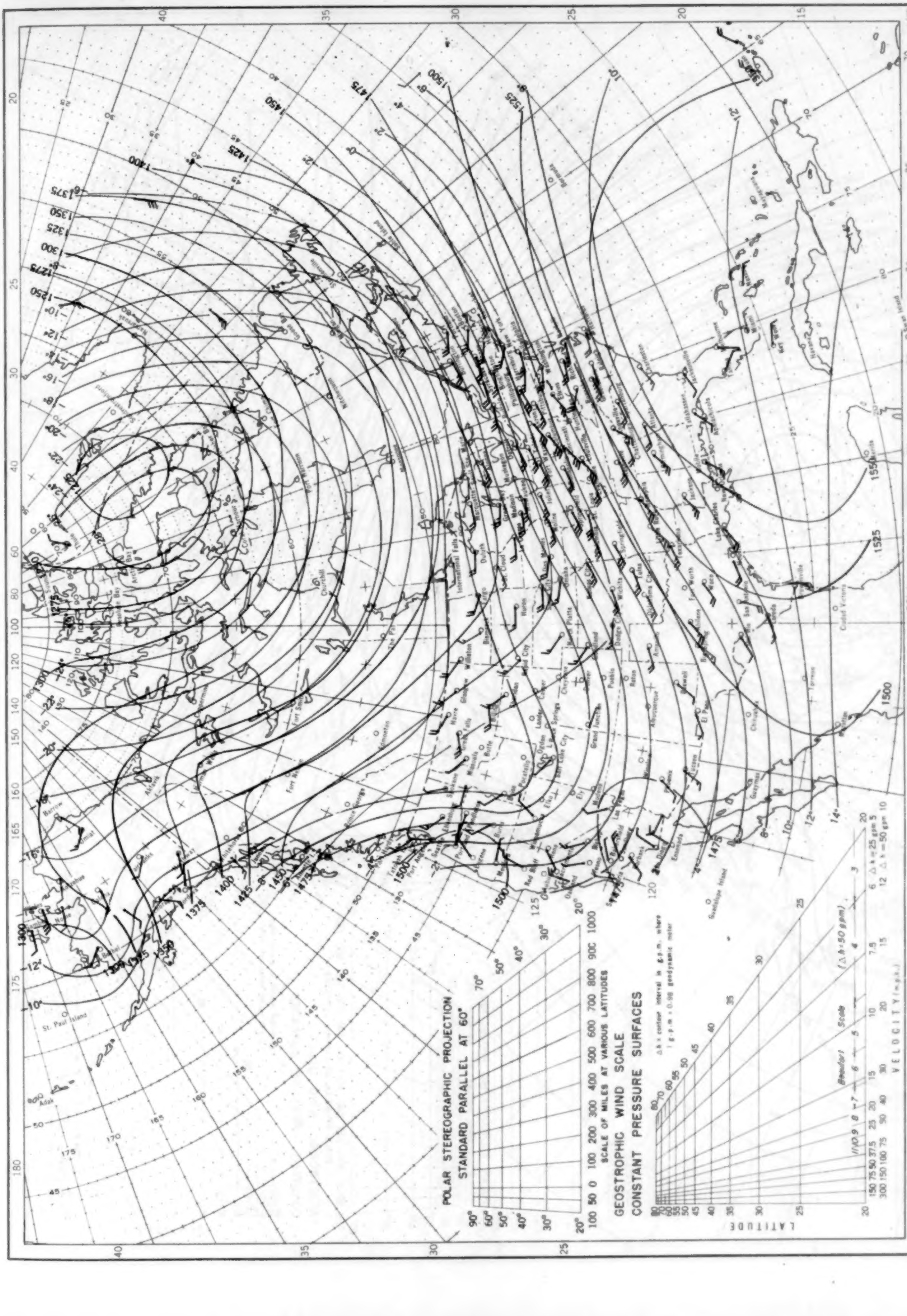


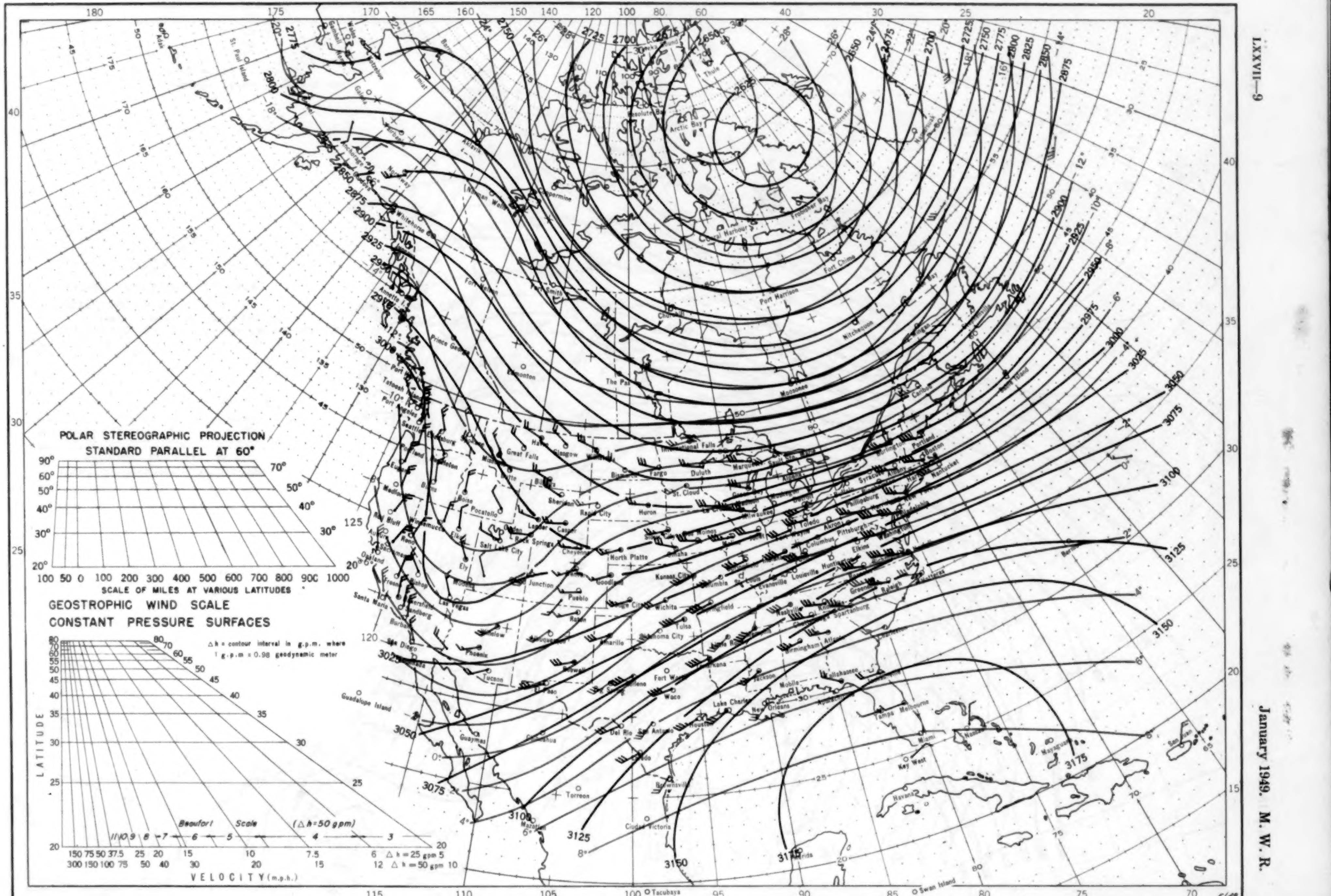
Chart VIII, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in

Chart VIII, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 850-millibar Pressure Surface, and Resultant Winds at 1,500 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

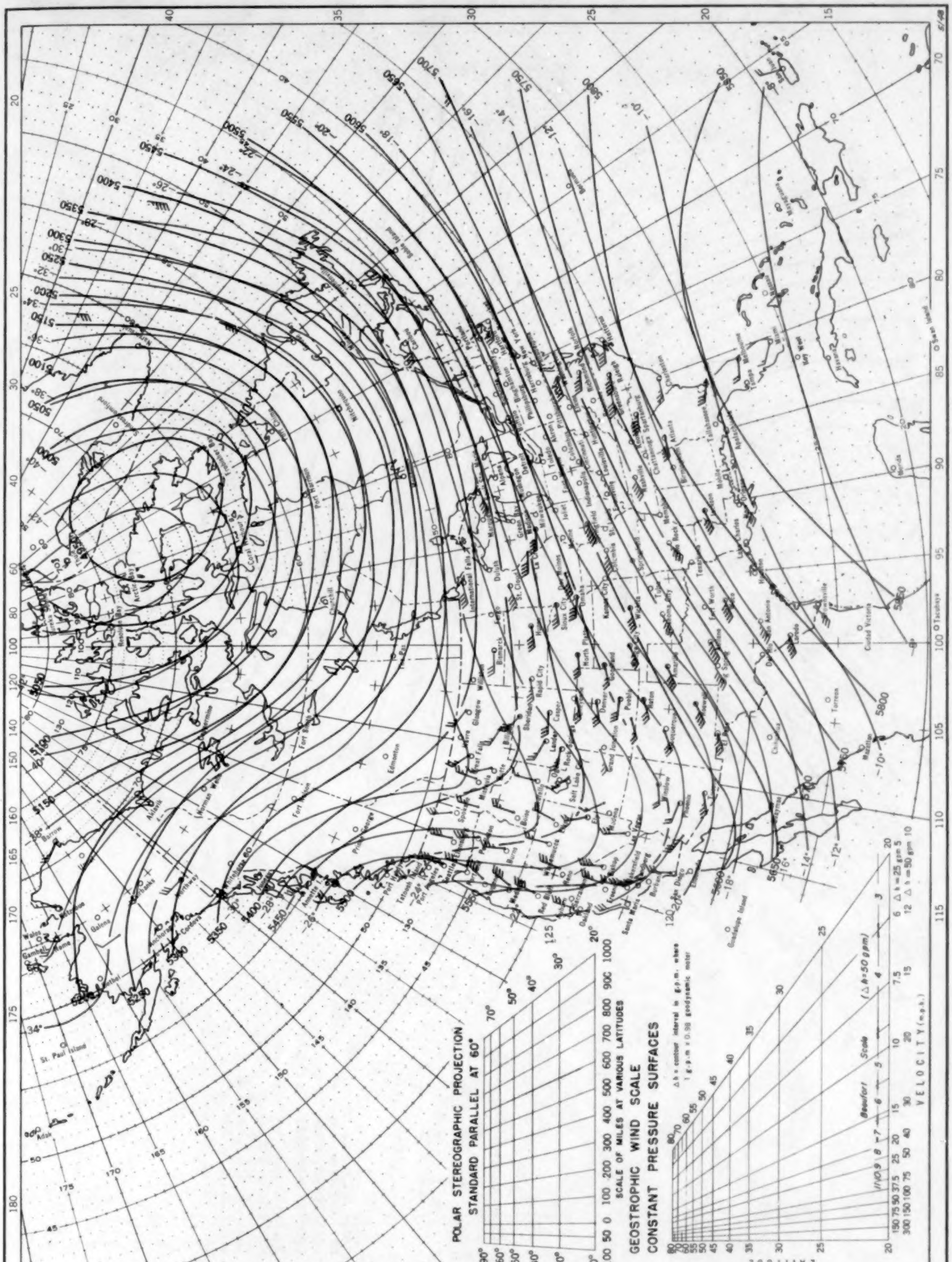
Chart IX, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 700-millibar Pressure Surface, and Resultant Winds at 3,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

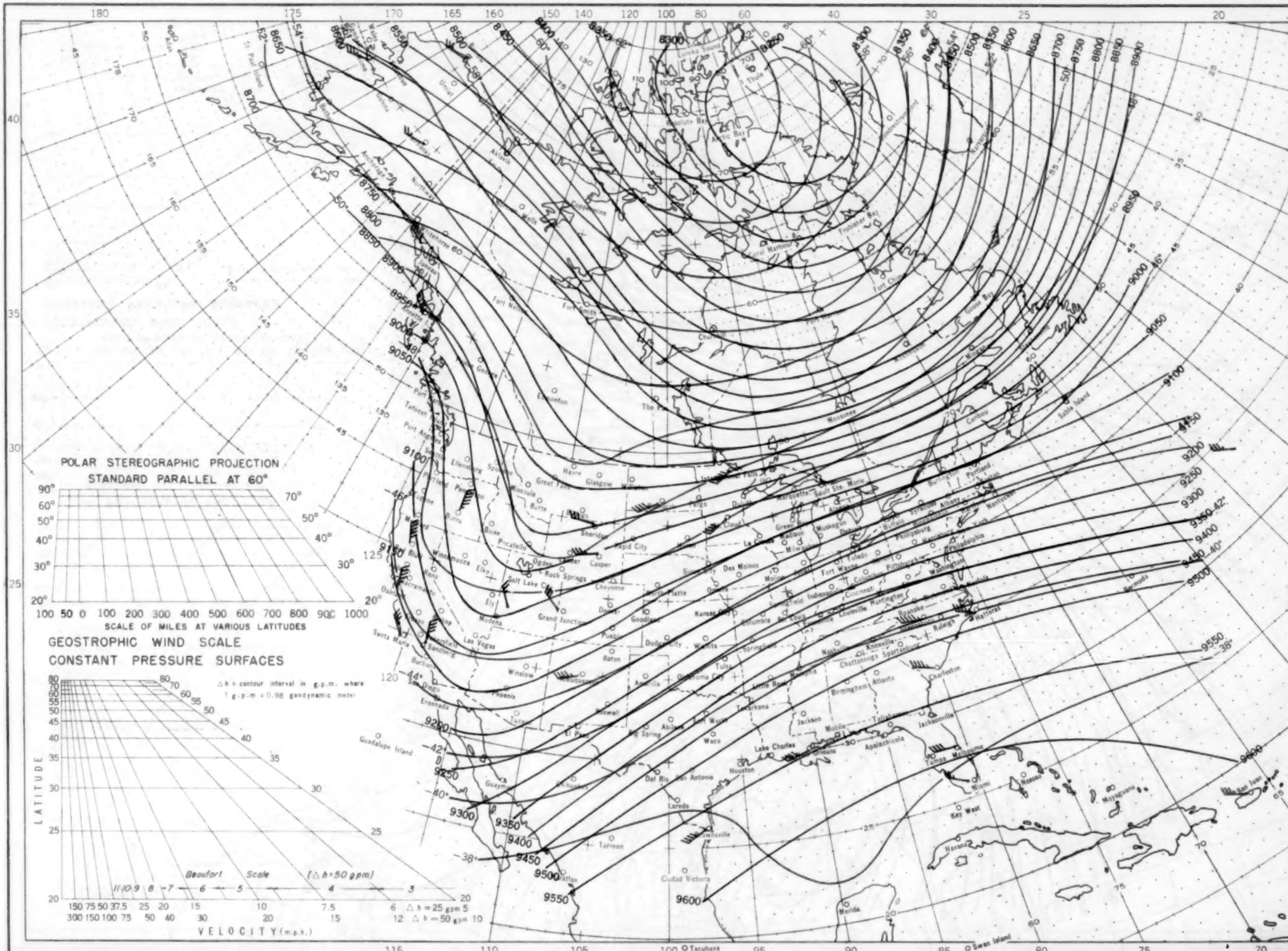
Chart X, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)

Chart X, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 500-millibar Pressure Surface, and Resultant Winds at 5,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.

Chart XI, January 1949. Contour Lines of Dynamic Height (Geopotential) in Units of 0.98 Dynamic Meters and Isotherms in Degrees Centigrade for the 300-millibar Pressure Surface, and Resultant Winds at 10,000 Meters (m. s. l.)



Contour lines and isotherms based on radiosonde observations at 0300 G. C. T. Winds indicated by black arrows based on pilot balloon observations at 2200 G. C. T.; those indicated by red arrows based on rawins taken at 0300 G. C. T.